Delta Agricultural Diversion Evaluation 1992 Pilot Study

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U.S. Environmental Protection Agency

Abstract

The objectives of this study are to:

- Develop reliable entrainment estimates for various fish species and life stages to Delta agricultural diversions during the irrigation season.
- Describe the susceptibility of various fish species to the diversions relative to their abundance and life stages in adjacent channels.

This pilot study focused on refining sampling techniques and assessing the suitability of four diversion sites. The McDonald Tract site was included to test the effectiveness of a fish screen installed on that intake. Sampling was conducted in diversions and adjacent channels from April through October 1992 for eggs and larvae, with some sampling for juveniles and older fish. Density and entrainment were estimated for eggs and larvae, and estimates of juvenile and older fish entrained were extrapolated where possible. The Wilcoxon signed-ranks test was used to compare diversion and channel densities of eggs and larvae by species at diversion sites and for the fish screen test.

Results indicate vulnerability of eggs and larval fish to entrainment tends to vary between species and appears to depend on seasonal occurrence, abundance, and distribution of a species in the adjacent Delta channel and on operations of the diversion. Larval threadfin shad at McDonald Tract were more susceptible to entrainment than channel density indicated. Density in the diversions was significantly ($P<0.01$) higher than in the channel. Larvae of threadfin shad (other sites), centrarchids, cyprinids, and logperch were as susceptible to entrainment as channel density indicated. Threadfin shad (2 sites) and centrarchid (all sites) diversion density was not significantly different from channel densities, and no difference was found for cyprinids and logperch at Bacon Island. Chameleon goby, striped bass, and prickly sculpin larvae were less vulnerable to diversions than channel density indicated. Diversion density was significantly ($P<0.01$) lower than channel density for these species at Bacon Island and for chameleon goby at other sites. Chameleon goby, threadfin shad, and centrarchids were the most abundant larval species entrained by the diversions.

Fish screen test results indicated no significant difference between unscreened and screened density of threadfin shad eggs. Density of larval threadfin shad and chameleon goby was significantly lower with screens ($P<0.01$) than without ($P<0.05$); the same was true for centrarchids ($P<0.05$). The screen was effective in reducing entrainment of larvae 4-5 mm TL and larger.

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Acknowledgments

I thank all the people who helped in this first year effort. Leo Winternitz helped get this study off the ground in its early stages and provided guidance throughout. Larry Chee obtained entry permits to the diversion sites, flowmeters and their installation, and miscellaneous sampling gear. The crew of the *Beowulf II*, Ron Lunsford, Pam Casselman, and Teresa MacColl, spent long days collecting channel samples. Rory Fagan, Kelly Cohen, and Katie Wadsworth also spent many long days collecting diversion samples. We received a lot of valuable assistance from the Department of Fish and Game, Stockton, in evaluating the sampling procedures and gear. Curtis Hagen and Jim Starr helped immensely with their electrofishing efforts during these evaluations. Johnson Wang provided invaluable services on identification and enumeration of our egg and larval samples.

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Introduction

The peak agricultural diversion season in the Sacramento-San Joaquin Delta is April through August. This coincides with months when large numbers of young Chinook salmon[1], striped bass, American shad, delta smelt, and other fish species are present in the system. Entrainment to agricultural diversions may be a substantial source of mortality for early life stages of some Delta fish species.

Little is known about the extent of entrainment to agricultural diversions or the factors affecting losses. Brown[2] estimated striped bass losses to be several hundred million for fish less than 16 mm SL[3]. Chinook salmon losses were estimated to be a few hundred thousand. Based on a limited study on Sherman Island adjacent to the San Joaquin River, Allen[4] reported that concentrations of striped bass eggs and young from the diversions were statistically identical to those in the adjacent river channel (up to 5.8 eggs/cubic meter and 2 fish/cubic meter of water). Although there was no significant difference between the daily mean length of young collected in the river (3-34 mm SL) and those diverted (4-16 mm SL), bass between 17 and 34 mm were taken only in the river. Allen indicated the most plausible explanation was that larger young bass swim well enough to avoid the influence of operating siphons.

Due to concerns about water diversions and impacts on fishery resources, fish screening requirements are covered in three sections of the California Fish and Game Code. These sections cover screening requirements for diversions over 250 cfs (Section 5980), diversions 250 cfs or less (Section 6020), and new diversions installed since January 1, 1972 (Section 6100). In addition, National Marine Fisheries Service is considering proposing regulations that would establish screening requirements for water diversions from the Sacramento River and Delta to protect threatened winter-run Chinook salmon[5].

The Delta Agricultural Diversion Evaluation is designed to estimate fish entrainment at representative agricultural diversions. The objective is to develop reliable entrainment estimates of various fish species and life stages to agricultural diversions during the irrigation season, and to describe their susceptibility to these diversions, relative to their abundance and life stages in adjacent channels. The knowledge gained from the study will be used to design and evaluate mitigation proposals to reduce entrainment, such as consolidating or screening agricultural diversions and modifying water use patterns on Delta islands.

As the first year of a 3-year study, 1992 focused on refining sampling techniques and assessing the suitability of the selected sites to meet the study objective. Parts of this study were mandated by the U.S. Army Corps of Engineers permit for the Temporary Barriers Project[6] in the southern Delta and by the Delta Smelt Study Plan[7].

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1 Scientific names of fish that may be mentioned in this and other Interagency Program reports are printed inside the back cover.

2 R.L. Brown. *Screening Agricultural Diversions in the Sacramento-San Joaquin Delta.* Department of Water Resources, Internal Report. 1982. 42 pp.

3 Definitions of abbreviations commonly used in Interagency Program reports are printed inside the back cover.

4 D.H. Allen. *Loss of Striped Bass Eggs and Young through Small, Agricultural Diversions in the Sacramento-San Joaquin Delta.* Department of Fish and Game, Anadromous Fisheries Branch, Administrative Report 75-3. 1975.

5 Federal Register, Vol. 28, No. 199, issued October 18, 1993.

6 Permit 199101051, effective March 30, 1992.

7 D.A. Sweetnam and D.E. Stevens. *Delta Smelt Study Plan.* Department of Fish and Game. October 1991. 46 pp.

Study Area

In March 1992, four sites were selected in the central and southern Delta as representative agricultural diversions (Figure 1). In compliance with the Temporary Barriers Project permit, two agricultural diversion study sites (2 and 4) were selected based on the following criteria:

- Location south and west of the San Joaquin River.
- Right-of way-clearance.
- Landside sampling accessibility.
- Diversion equipment, operation, and volume representative of southern Delta agricultural diversions.
- Availability of channel fishery data.
- Feasibility of diversion for remedial action, if warranted by study.

One site (Site 2) was in the central Delta on the east side of Bacon Island, adjacent to Middle River. The other (Site 4) was in the southern Delta south of Fabian Tract and Old River within Naglee Burk Irrigation District.

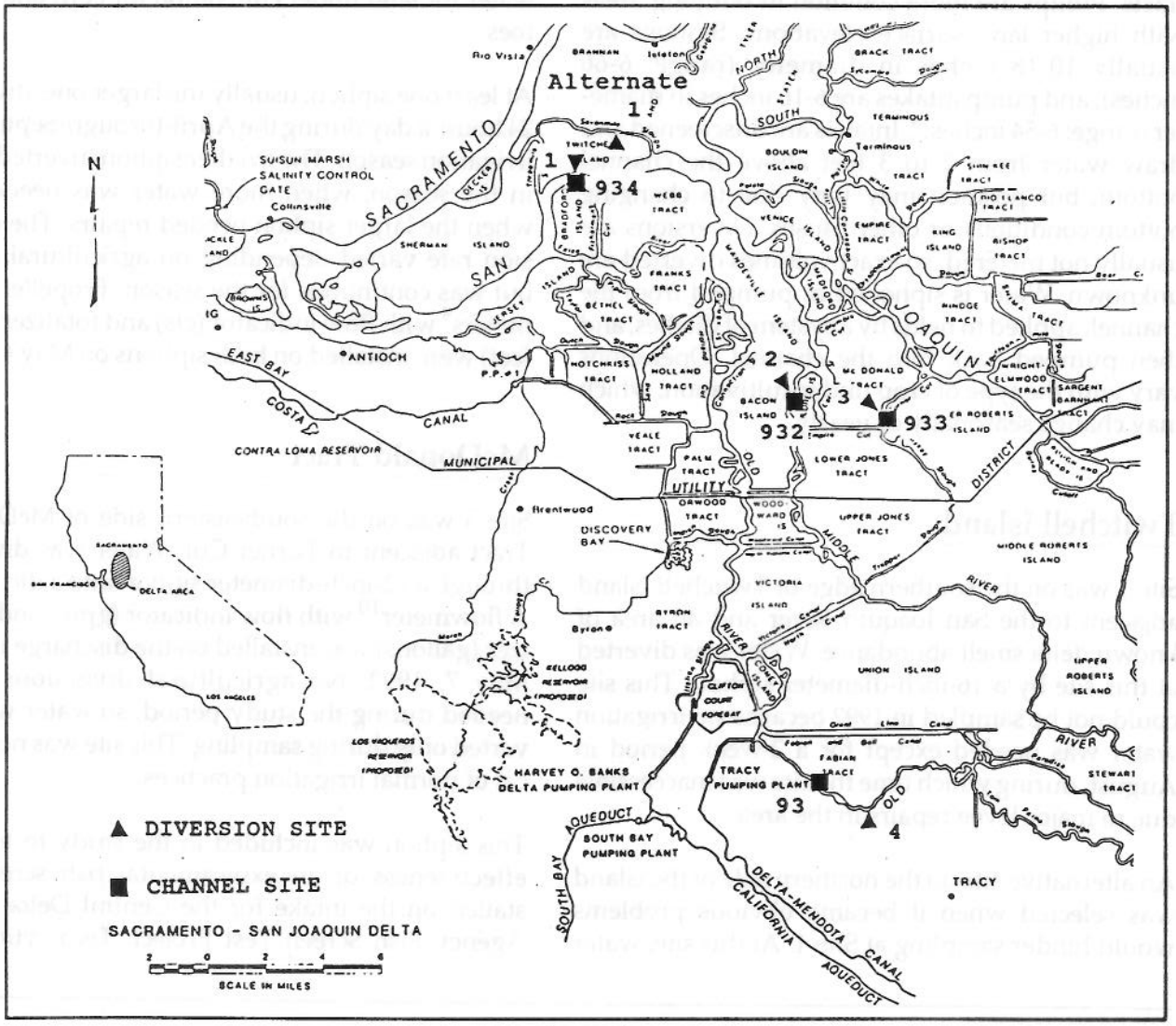

Figure 1
DIVERSIONS AND ADJACENT CHANNEL SITES SAMPLED
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Two additional sites were selected based on the same general criteria. At least one site was to be adjacent to a known area of delta smelt abundance. The diversion site on Twitchell Island (Site 1) was near an area of the San Joaquin River where delta smelt have been abundant in past years. The Department of Water Resources owns the property at this site, thus providing access. The site on McDonald Tract (Site 3) was chosen because the landowners had installed an experimental fish screen for testing.

In the Delta, two general types of agricultural diversions are used, siphons or pumps, depending on the elevation of the land under irrigation. Siphons are common on Delta islands and low lying adjoining tracts. Pumps are more common in outlying areas with higher land surface elevations. Siphons are usually 10-18 inches in diameter (range: 6-66 inches), and pump intakes are 6-16 inches in diameter (range: 6-54 inches)[8]. Intakes are unscreened and draw water from 2 to 3 feet above the channel bottom, but position may vary due to changing bottom conditions or other causes. Diversions are usually not metered, so exact volumes diverted are unknown. Water is siphoned or pumped from the channel, applied to fields by a system of ditches, and then pumped back into the channel. Operations vary with the type of crop under cultivation, which may change seasonally or yearly.

Twitchell Island

Site 1 was on the southern edge of Twitchell Island adjacent to the San Joaquin River and an area of known delta smelt abundance. Water was diverted at this site by a 16-inch-diameter siphon. This site could not be sampled in 1992 because no irrigation water was needed except for a 2-week period in August, during which time the site was inaccessible due to major levee repairs in the area.

An alternative site on the northern side of the island was selected when it became obvious problems would hinder sampling at Site 1. At this site, water was diverted from Sevenmile Slough by an 18-inch siphon into a concrete box that emptied into a small pond. One irrigation ditch carried water south and a second to the east. The diversion rate varied depending on agricultural needs and was not continuous for the season. Since this was an alternative site, no flowmeter was installed on the siphon.

Bacon Island

Located on the eastern side of Bacon Island, this site was on an outside bend of Middle River. Two siphons diverted water into a common dirt ditch. One siphon was 14 inches in diameter and the other was 16 inches. These siphons provided agricultural water for land under cultivation for corn and potatoes.

At least one siphon, usually the larger one, diverted 24 hours a day during the April-through-September irrigation season. The smaller siphon diverted early in the season, when more water was needed, or when the larger siphon needed repairs. The diversion rate varied depending on agricultural needs but was continuous for the season. Propeller flowmeters[9] with flow indicator (cfs) and totalizer (acre-feet) were installed on both siphons on May 4, 1992.

McDonald Tract

Site 3 was on the southeastern side of McDonald Tract adjacent to Turner Cut. Water was diverted through a 12-inch-diameter siphon into a dirt ditch. A flowmeter[10] with flow indicator (gpm) and totalizer (gallons) was installed on the discharge line on May 7, 1992. No agricultural diversions were needed during the study period, so water was diverted only during sampling. This site was not typical of normal irrigation practices.

This siphon was included in the study to test the effectiveness of an experimental fish screen installed on the intake for the Central Delta Water Agency Fish Screen Test Project. Two cylindrical

8 Department of Water Resources, unpublished data.
9 Ketema McCrometer Model M0300.
10 Ketema McCrometer Model M0300.

fish screens[11] were installed on a hinged pipe tee (Figure 2).

The hinged tee was a modification of the swivel joint used by the screen manufacturer (Figure 3). The screen was made of stainless steel mesh with 2.3-mm diagonal openings.

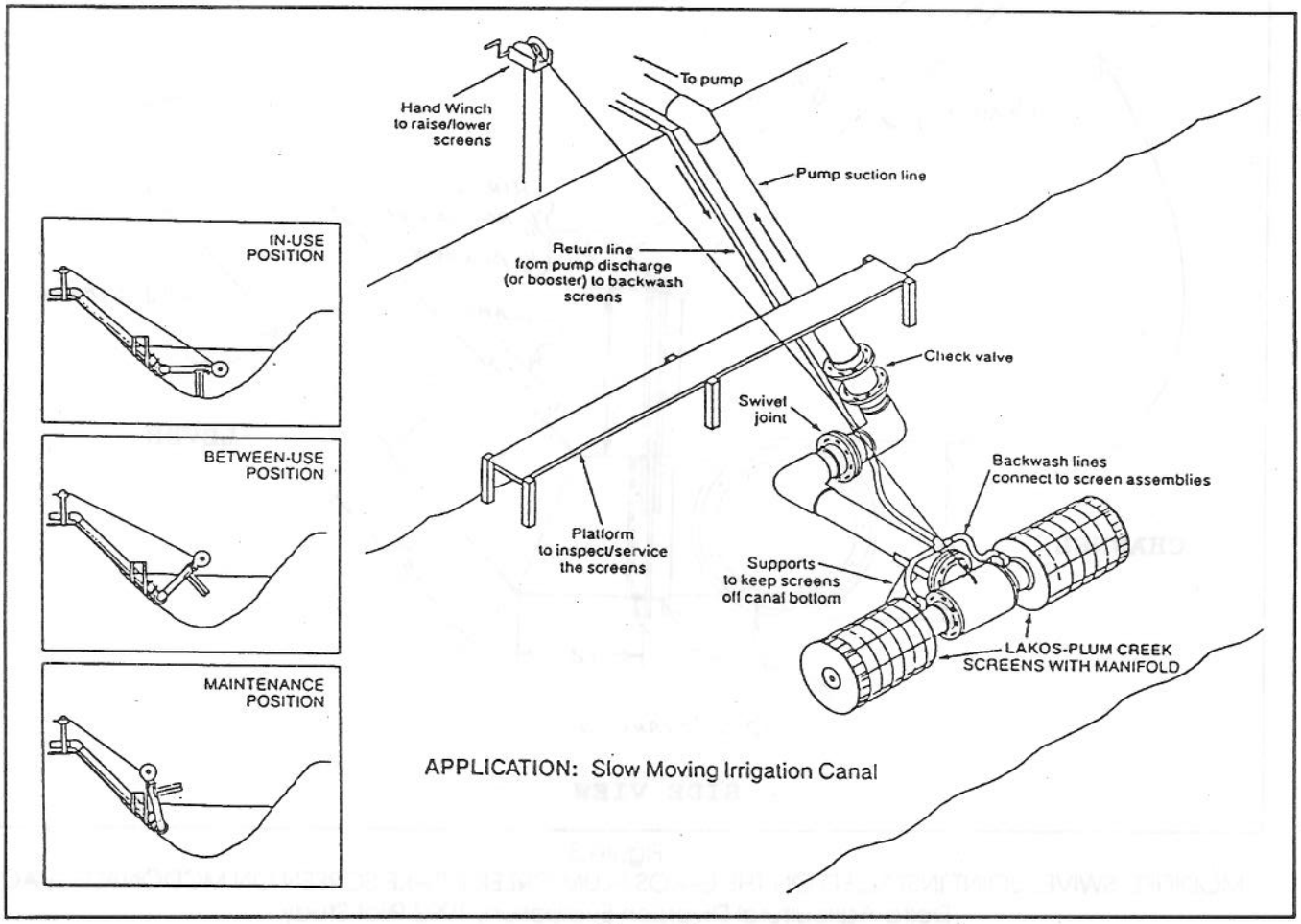

Figure 2
LAKOS-PLUM CREEK SELF-CLEANING PUMP INTAKE SCREEN INSTALLED ON MCDONALD TRACT
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

11 Lakos-Plum Creek type.

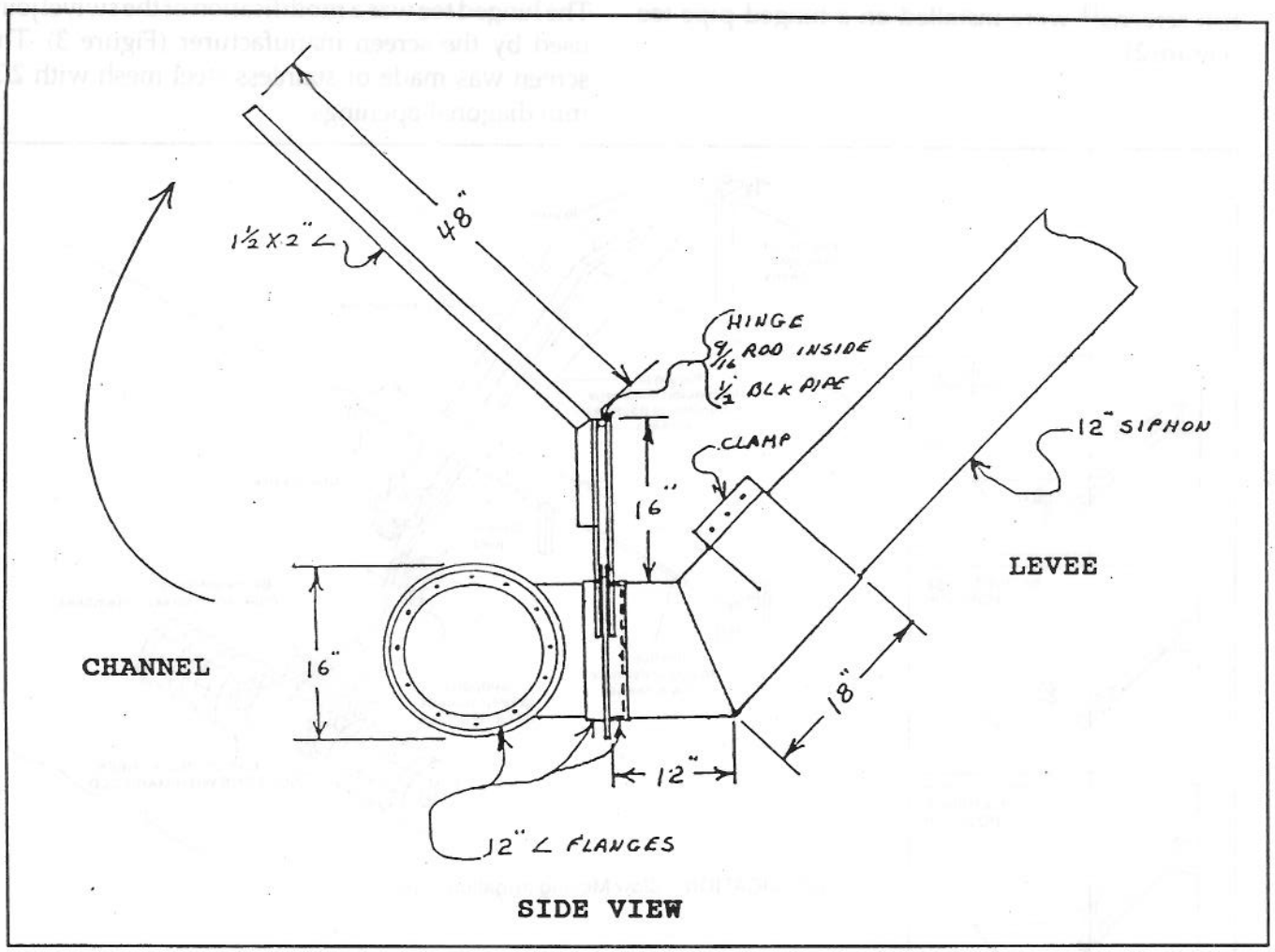

Figure 3
MODIFIED SWIVEL JOINT INSTALLED ON THE LAKOS-PLUM CREEK INTAKE SCREEN ON MCDONALD TRACT
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Naglee Burk

Site 4 was on an outside bend of Old River upstream of the temporary barrier site near Tracy Pumping Plant. At this site, water was diverted by a pump with a 12-inch-diameter intake into a 20-inch-diameter discharge pipe and into a concrete box that allowed water to be released to the south or east. The main irrigation ditch was concrete lined and carried water southwesterly to agricultural fields under cultivation for alfalfa and corn. A smaller, secondary concrete ditch carried water to the northeast, along the toe of the levee, to an area under cultivation for sugar beets.

The irrigation period for this diversion was about mid-April through mid-November. The diversion rate varied between 15 and 20 cfs, depending on agricultural needs. Water diversion was not continuous at this site, and the pump was completely shut down for periods of 7 to 10 days or longer. Water was primarily released into the south ditch, but occasional releases were also made to the east ditch. A propeller flowmeter[12] with flow indicator (cfs) and totalizer (acre-feet) was installed on the discharge line on September 4, 1992. Installation was delayed due to coordination difficulties between the ditch tender and the company contracted to install the meter.

12 Ketema McCrometer Model M0300.

The pilot study focused on two general life stages of fish: eggs/larvae and juveniles/older fish. Sampling for these life stages was conducted at the diversion and in the adjacent channel. Most of the 1992 sampling effort focused on eggs and larvae due to delays in obtaining sampling gear for larger fish.

Sampling was conducted from April through October, depending on location and type of sampling (Table 1). Generally, two or three samples were collected each week at each site if the site was diverting.

Sampling Eggs and Larvae

Egg and larval samples were collected in the irrigation ditches using a 0.5-meter-diameter, conical plankton net, 8 feet long, made of 505-micron mesh Nitex netting. A quart plastic collecting jar, screened with 470-micron mesh bolting cloth, was attached at the cod end to collect samples. Each net was fished with a bridle and line from a catwalk spanning the ditch. A digital flowmeter[13], mounted in the mouth of the net, was used to measure flow through the net and subsequently compute the cubic meters of water sampled. When available, flowmeter readings from the diversion pipe were recorded with each sample as flow and total volume diverted. Water temperature (degrees Fahrenheit) and surface specific conductance (µS/cm) were measured at each site.

Egg and larval data from channels adjacent to the agricultural diversion sites were collected at stations 93 (Naglee Burk), 932 (Bacon Island), 933 (McDonald Tract), and 934 (Twitchell Island) (Figure 1). Station 93 was part of the South Delta Egg and Larval Study and was 2.5 miles downstream of the Naglee Burk diversion. The station was moved downstream of the temporary barrier on Old River near Tracy on April 28, when the original site became inaccessible due to closure of the barrier. Stations 932-934 were added to the egg and larval survey for this study.

Sampling at station 93 began February 20 and ended July 15, 1992. Stations 932-934 were sampled from early-April to late September (Table 1). Samples were taken at each station every 4 days until April 4

Table 1
SUMMARY OF
SITE CHARACTERISTICS, PERIOD OF SAMPLING, AND TYPE OF SAMPLING
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Site No.	Location	Diversion Type	Diversion Size	Diversion Operation		Sampling Period Diversion	Sampling Period Channel
1	Twitchell Island[1]	Siphon	18"	Intermittent	EL:	Jun 24-Sep 22	Apr 14-Sep 23
					JUV:	Jul 9; Sep 21- 22; Oct 7, 9	Jul 21-Sep 8
2	Bacon Island	Siphon	16"/14"	Continuous	EL:	Apr 22-Oct 23	Apr 6-Sep 23
					JUV:	Jun 29-Oct 23	Jul 21-Sep 8
3	McDonald Tract	Siphon	12"	Intermittent	EL:	May 6-Aug 19	Apr 6-Sep 23
					JUV:	Jun 30; Jul 6- 9; Aug 19	Jul 21-Sep 8
4	Naglee Burk	Pump	20"; 30 hp	Intermittent	EL:	May 6-Oct 2	Feb 20-Jul 15
					JUV:	Aug 5-Oct 2	Jul 21-Sep 6

1 Alternative site on Sevenmile Slough
EL = Eggs and Larvae; JUV = Juvenile and Older Fish

13 General Oceanics Model 2030.

and then every other day until July 15. After July 15, stations 932-934 were sampled at least once a week until late September.

Channel samples were collected by making a single 10-minute oblique tow, regardless of tidal stage, at each station using an egg and larval net mounted on a towing frame with skis.[14] Sampling methods are essentially identical to those used by the Department of Fish and Game in its Delta-wide striped bass egg and larval sampling program.

At the end of each channel tow or ditch sample, contents of the net were rinsed into a collecting jar, and the samples were preserved in 5% formalin. Rose bengal dye was added to make the eggs and larvae more visible.

The Department of Water Resources contracted the egg and larval laboratory work to consultant Dr. Johnson Wang, National Environmental Sciences, Inc. In the lab, samples were rinsed thoroughly with water through a No. 50 sieve (300-micron mesh) to remove formalin, excess dye, and algae. Each sample was sorted under a magnifying illuminator, and all eggs and larvae were removed and counted. Eggs were identified to species, where possible, and counted; striped bass eggs were further classified as dead, morula, early embryo, or late embryo. Fish larvae were classified to species, and in some cases only to genus or family. Larvae were measured to the nearest millimeter total length.

Sampling Juveniles and Older Fish

Juvenile sampling began June 29, 1992. Sampling was delayed because the nets ordered in March did not arrive until late June. Some extended sampling was conducted during daylight and evening hours to provide information regarding tidal effects and nighttime activity.

Juvenile samples were generally collected using a 1x1-meter net, 16 feet long, made of 1/8-inch Delta-type mesh with 10-foot wings attached. The nets were set in the irrigation channels and fished 100% of the flow at Naglee Burk and about 90-95% of the flow at Bacon Island. Three sizes of live boxes were used throughout the season to determine the best size for future sampling. Two of the live boxes were large versions of cod-end jars and were 4.5 inches and 6.625 inches in diameter with 1000-micron mesh Nitex netting. The third box was 2x2x4 feet and made of 1/8-inch mesh netting with a 1-inch PVC pipe frame.

Two other sampling methods were also tested. A 1.4x1-meter net, 18-1/2 feet long, of 1/8-inch Delta-type mesh on a stainless steel frame was used to sample the siphon outfall directly at Bacon Island. Also, DFG tested electrofishing with a backpack shocker at both sites, in conjunction with the channel nets.

All fish caught were identified to species, enumerated, and measured to the nearest millimeter total length or fork length, depending on the species. If identification was not possible, the fish were returned to the lab for positive identification. The volume of water sampled was determined from the flowmeters installed on the diversion outfall.

A tow-net was obtained from DFG on June 20 to sample juveniles in adjacent channels. Tow-net methods were essentially the same as those used by DFG in the Delta-wide tow-net survey. Sampling did not begin until July 21 due to modifications required for this gear on the sampling boat. Tow-net sampling was conducted at stations 932-934 through September 8 about once or twice a week. The Naglee Burk site was inaccessible to the sampling boat due to the temporary barrier at Old River near Tracy. However, DFG sampled monthly at a nearby site by hoop-netting and electrofishing.

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14 S.A. Spaar. *1992 Entrainment of Striped Bass Eggs and Larvae to the State Water Project and Central Valley Project Intakes in the Sacramento-San Joaquin Delta.* Department of Water Resources Memorandum, May 28, 1990.

Data Analysis

Sampling data were analyzed to determine susceptibility of fish species and life stages to the agricultural diversions through the coordination of diversion studies with sampling in adjacent channels from which water was diverted.

Densities (organisms per cubic meter) were estimated for all eggs and larvae for each sample site by sample day. Estimates of the number of eggs and larvae entrained by the agricultural diversions were derived from the landside density estimates of eggs and larvae at the sample sites. Estimates of the number of juvenile and older fish entrained were extrapolated from the landside numbers of fish captured per volume of water diverted over the sample period. Diversions at each site were multiplied by the appropriate density of eggs and larvae or numbers of fish to estimate entrainment.

The Wilcoxon signed-ranks test was used to analyze and compare diversion and channel densities of eggs and larvae by species at each diversion site except Twitchell Island.[15] Paired samples of diversion and channel densities for the same date were tested. If no channel data were available for a given diversion sample date, channel densities for each species were estimated as the mean of densities on the date preceding and following the diversion sample date (only if within 1-2 days). Similarly, paired samples of eggs and larvae under screened and unscreened conditions at McDonald Tract were tested.

15 R.R. Sokal and F.J. Rohlf. *Biometry*. W.H. Freeman and Company, New York. 1981. 859 pp.

Results

The pilot study results are separated into three areas: eggs and larvae, juvenile and older fish, and McDonald Tract fish screen test. Results include species occurrence, species distribution and abundance, entrainment estimates where possible, and size distribution of the catch.

Eggs and Larvae

Results from sampling in the diversions and adjacent Delta channels indicate eggs and larval fish are susceptible to entrainment into agricultural diversions. The degree of vulnerability to entrainment tends to vary between species. Entrainment appears to depend largely on seasonal occurrence, abundance, and distribution of a species in the adjacent channel and operations of the diversion.

Species Occurrence

Larval species collected from the agricultural diversions appear to be a subset of the species present in the adjacent channels (Table 2). This does not apply to results from Twitchell Island where the channel sampling was not adjacent to the alternative diversion sampled. The species represented in the channel catch at Twitchell Island are indicative of species potentially diverted if samples could have been obtained at Site 1. Among these species were striped bass (eggs and larvae), delta smelt, and splittail.

At Bacon Island, most of the nine species collected in the adjacent channel of Middle River were also collected on land (Table 2). Exceptions were delta smelt and Sacramento sucker. In addition, American shad larvae were collected from the diversion but not the channel. No eggs of any species were collected in Middle River or in the diversion.

At both the McDonald Tract and Naglee Burk sites, the occurrence of species in the diversion was a smaller subset of those found in the channel. At McDonald Tract, of eight larval species collected in Turner Cut, only three were found in the diversion: chameleon goby, threadfin shad, and centrarchids. Larvae of prickly sculpin, striped bass, bigscale logperch, cyprinids, and delta smelt were found in the channel but not in the diversion. In contrast, threadfin shad eggs and mosquitofish young were found only in the diversion.

Similarly, of the eleven species found in Old River near the Naglee Burk site, only five were actually collected from the diversion: chameleon goby, threadfin shad, centrarchids, bigscale logperch, and cyprinids. Eggs of striped bass, prickly sculpin, and cyprinids were collected in the channel but not in the diversion, as were larval striped bass, prickly sculpin, inland silverside, splittail, mosquitofish (juveniles), and ictalurids. In contrast, threadfin shad eggs and Sacramento sucker larvae were found in the diversion but not nearby in Old River.

Species Distribution and Abundance

Overall, several species were very abundant in the channel and diversion collections (Tables 2 and 3). Chameleon goby and threadfin shad were very abundant in both channel and diversion samples. Striped bass were also a very abundant channel species at Twitchell Island and prickly sculpin in Old River near the Naglee-Burk site. At all sites, prickly sculpin were moderate to highly abundant in channel samples but not in diversion samples.

A comparison of diversion and channel results could not be made for Twitchell Island. However, channel results indicate chameleon goby larvae and striped bass eggs and larvae were very abundant in the San Joaquin River adjacent to the diversion site (Figures 4 and 5; Appendix C). Both eggs and larvae (primarily 3-6 mm) of striped bass were abundant when sampling began in mid-April. Eggs were abundant through mid-May and larvae into early June. Delta smelt, prickly sculpin, and bigscale logperch larvae were collected from mid-April into May (Figure 4). Threadfin shad and chameleon goby were collected from April through August. Splittail were noted in mid-April only (Appendix C).

Table 2
SPECIES CATCH SUMMARY OF FISH EGGS AND LARVAE COLLECTED
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

(Blank spaces indicate zero catch.)

	Number Caught							
	Diversion Sites[1]				Channel Sites			
Species	1 Twitchell Island	2 Bacon Island	3 McDonald Tract	4 Naglee Burk	934 Twitchell Island	932 Bacon Island	933 McDonald Tract	93 Naglee Burk
Larvae:								
Chameleon goby		193	1865	130	5647	6491	20621	5299
Threadfin shad	8	90	1826	303	738	810	1744	1008
Prickly sculpin		8			413	748	530	2322
Striped bass		24			2956	326	37	25
Centrarchids	10	3	9	19	10	18	21	36
Bigscale logperch		6		1	17	30	73	52
Inland silverside	3							21
American shad		4						
Cyprinids		2		1	29	7	8	5
Delta smelt					19	7	3	
Sacramento splittail					1			3
Sacramento sucker				1		2		
Mosquitofish			3					2
Ictalurids								1
Yellowfin goby					4			
Total Larvae	**21**	**330**	**3703**	**455**	**9834**	**8439**	**23037**	**8774**
Eggs:								
Striped bass					689			
Striped bass (dead)								2
Threadfin shad			18	2				
Prickly sculpin								26
Cyprinid								1
Total Eggs	**0**	**0**	**18**	**2**	**689**	**0**	**0**	**29**

1 Site 1 alternative site sampled was a siphon diversion on Sevenmile Slough.

Table 3
TOTAL CATCH DENSITY OF FISH EGGS AND LARVAE COLLECTED
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

(Blank spaces indicate zero catch.)

	Number per Cubic Meter[1]							
	Diversion Sites[2]				Channel Sites			
Species	1 Twitchell Island	2 Bacon Island	3 McDonald Tract	4 Naglee Burk	934 Twitchell Island	932 Bacon Island	933 McDonald Tract	93 Naglee Burk
Larvae:								
Chameleon goby		19.95	35.19	4.07	55.25	50.30	203.62	34.83
Threadfin shad	1.13	12.26	42.17	10.12	6.17	5.96	15.19	6.16
Prickly sculpin		0.15			6.82	4.79	5.00	10.50
Striped bass		1.35			77.28	4.47	0.47	0.16
Centrarchids	1.19	2.24	0.17	0.90	0.11	0.13	0.19	0.21
Bigscale logperch		0.27		0.09	0.21	0.34	0.57	0.27
Inland silverside	5.70							0.10
American shad		0.04						
Cyprinids		0.14		0.22	0.68	0.10	0.19	0.02
Delta smelt					0.34	0.10	0.05	
Sacramento splittail					0.03			0.02
Sacramento sucker				0.58		0.05		
Mosquitofish			0.05					0.01
Ictalurids								0.01
Yellowfin goby					0.14			
Eggs:								
Striped bass					12.71			
Threadfin shad			0.11	0.60				
Prickly sculpin								0.10
Cyprinid								0.01
Number of Samples	7	69	30	30	44	52	52	46

1 Density +1233.49 acre-feet = number per acre-foot.
2 Site 1 alternative site sampled was a siphon diversion on Sevenmile Slough.

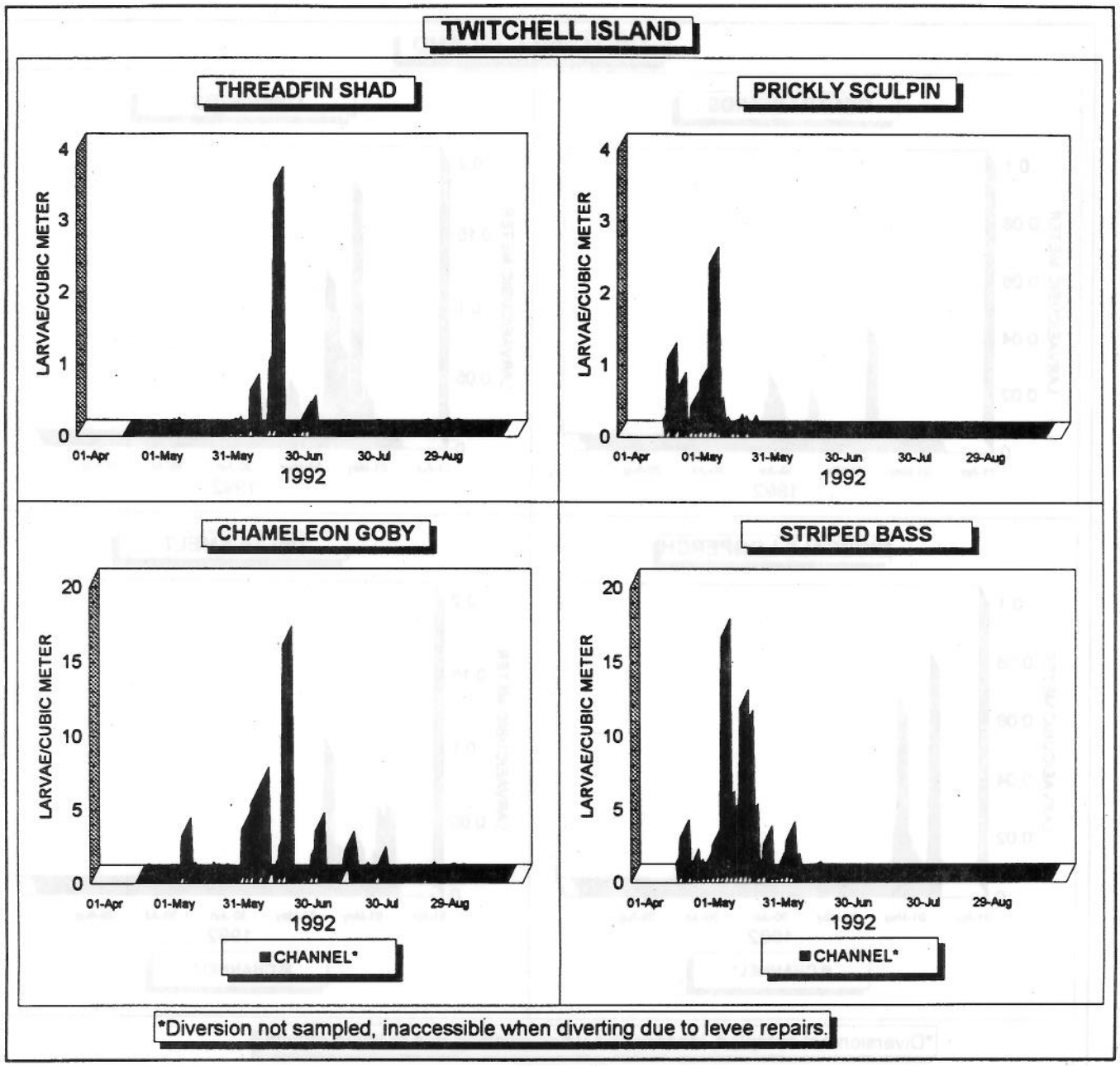

Figure 4
ESTIMATED DENSITY OF LARVAE IN THE SAN JOAQUIN RIVER
ADJACENT TO TWITCHELL ISLAND DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

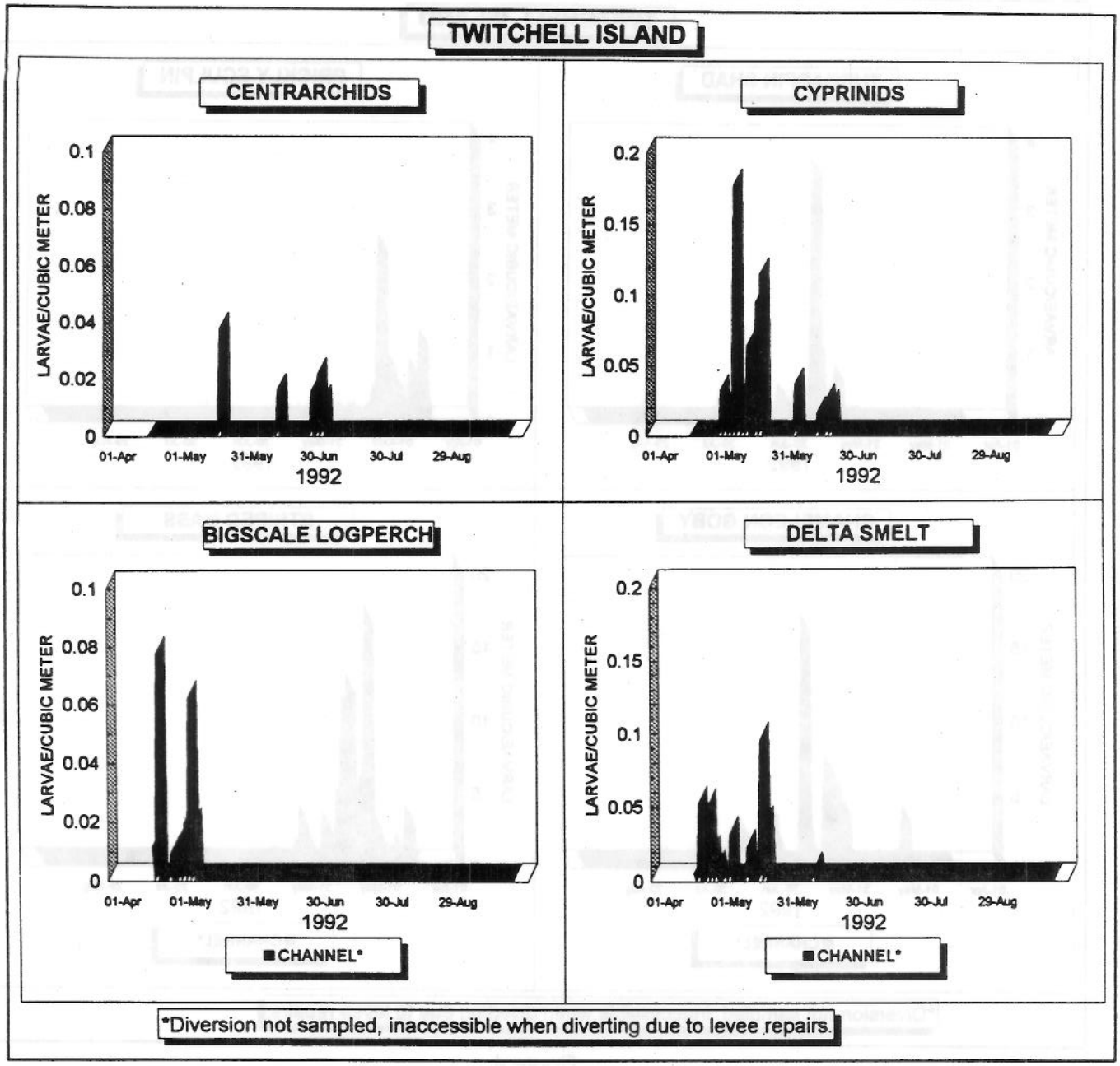

Figure 4 (continued)
ESTIMATED DENSITY OF LARVAE IN THE SAN JOAQUIN RIVER
ADJACENT TO TWITCHELL ISLAND DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

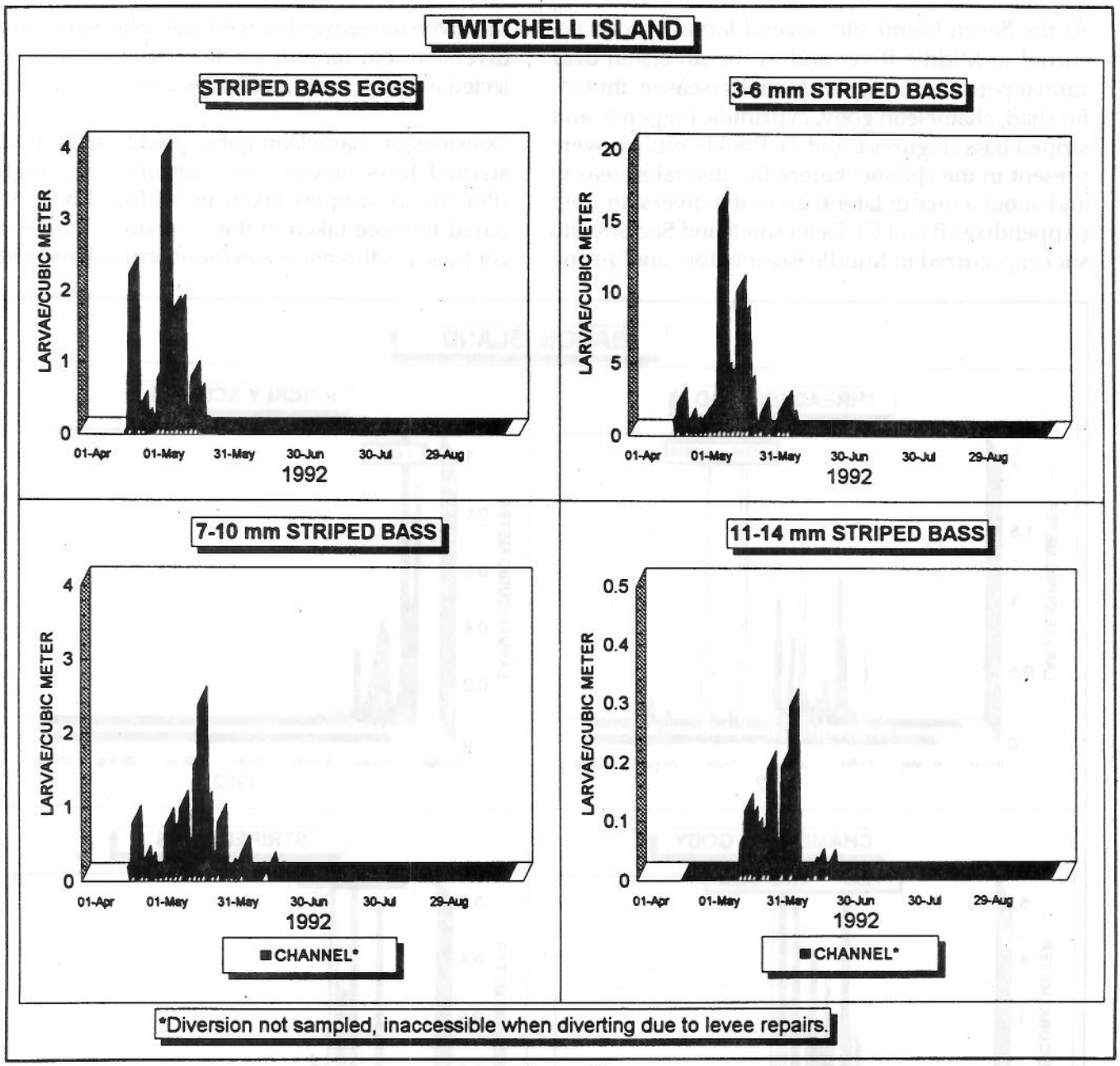

Figure 5
ESTIMATED DENSITY OF STRIPED BASS EGGS AND LARVAE IN THE SAN JOAQUIN RIVER ADJACENT TO TWITCHELL ISLAND DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

At the Bacon Island site, several larval species occurred in Middle River and in the diversion over similar periods during the diversion season: threadfin shad, chameleon goby, cyprinids, logperch, and striped bass (Figures 6 and 7). Prickly sculpin were present in the channel before the diversion season and about a month later than in the diversion itself (Appendixes B and C). Delta smelt and Sacramento sucker occurred in Middle River before and during the diversion season but were not collected from the diversion. No longfin smelt or splittail were collected at either location (Tables 2 and 3).

Densities of chameleon goby, prickly sculpin, and striped bass larvae were significantly higher ($P<0.01$) in samples taken in Middle River compared to those taken in the diversion (Table 4). In contrast, no difference was found in the densities for

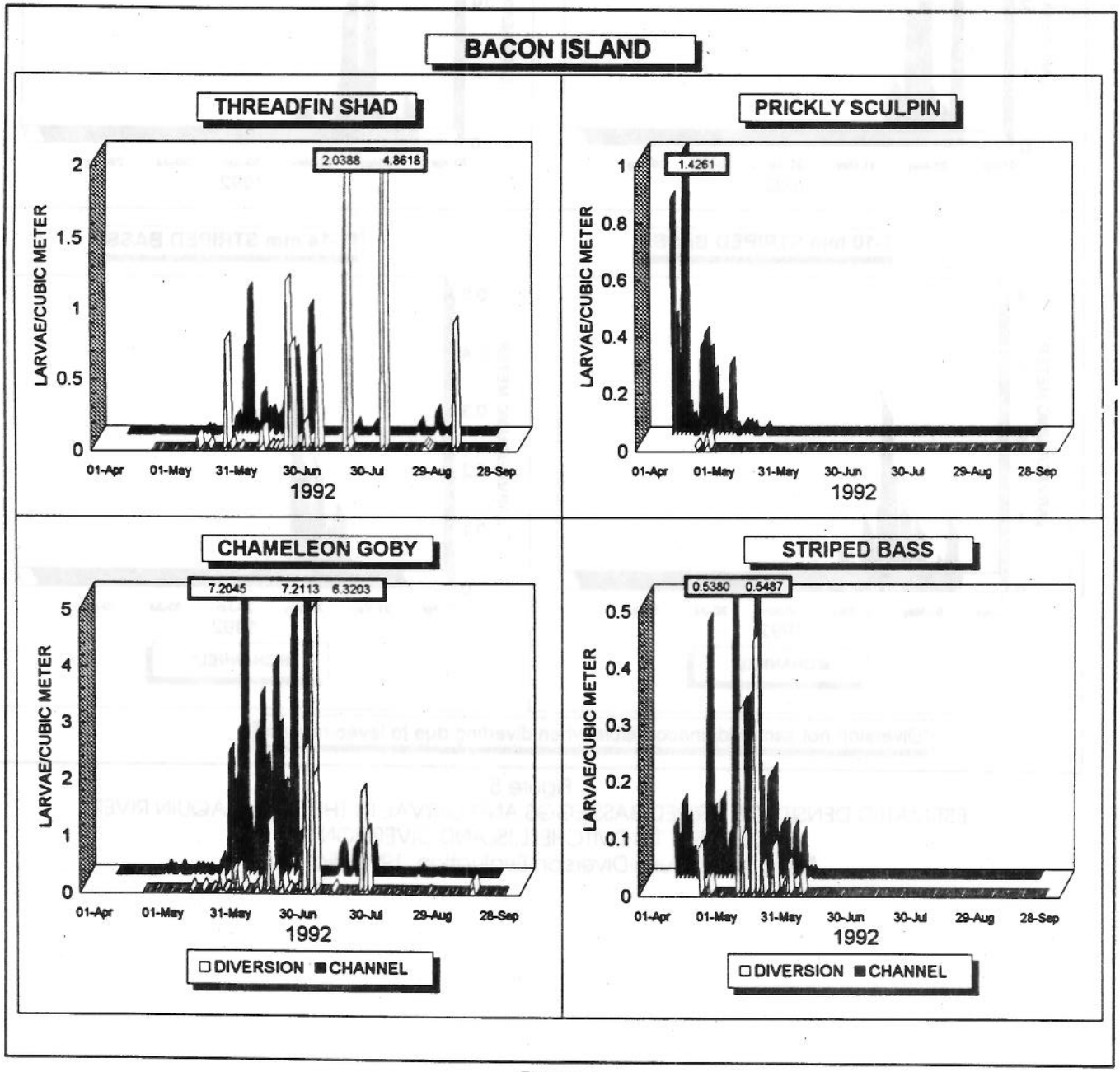

Figure 6
ESTIMATED DENSITY OF LARVAE IN MIDDLE RIVER
AND AT BACON ISLAND DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

threadfin shad, centrarchids, cyprinids, and logperch between Middle River and the diversion.

A comparison of striped bass channel and diversion densities indicates the occurrence of striped bass larvae in the Bacon Island diversion was sporadic when compared with their occurrence in Middle River (Figure 7). Channel densities were significantly greater ($P<0.01$) than diversion densities (Table 4). Larvae (3-20 mm) occurred from April into June in both the channel and diversion. Larvae in the 3-6 mm and 7-10 mm size groups occurred much less frequently in the diversion than in the channel, but densities appear to be of similar magnitude on days when they were collected in both areas. No 11-14 mm (and up to 20 mm) larvae were collected in the diversion, but they were collected from the channel.

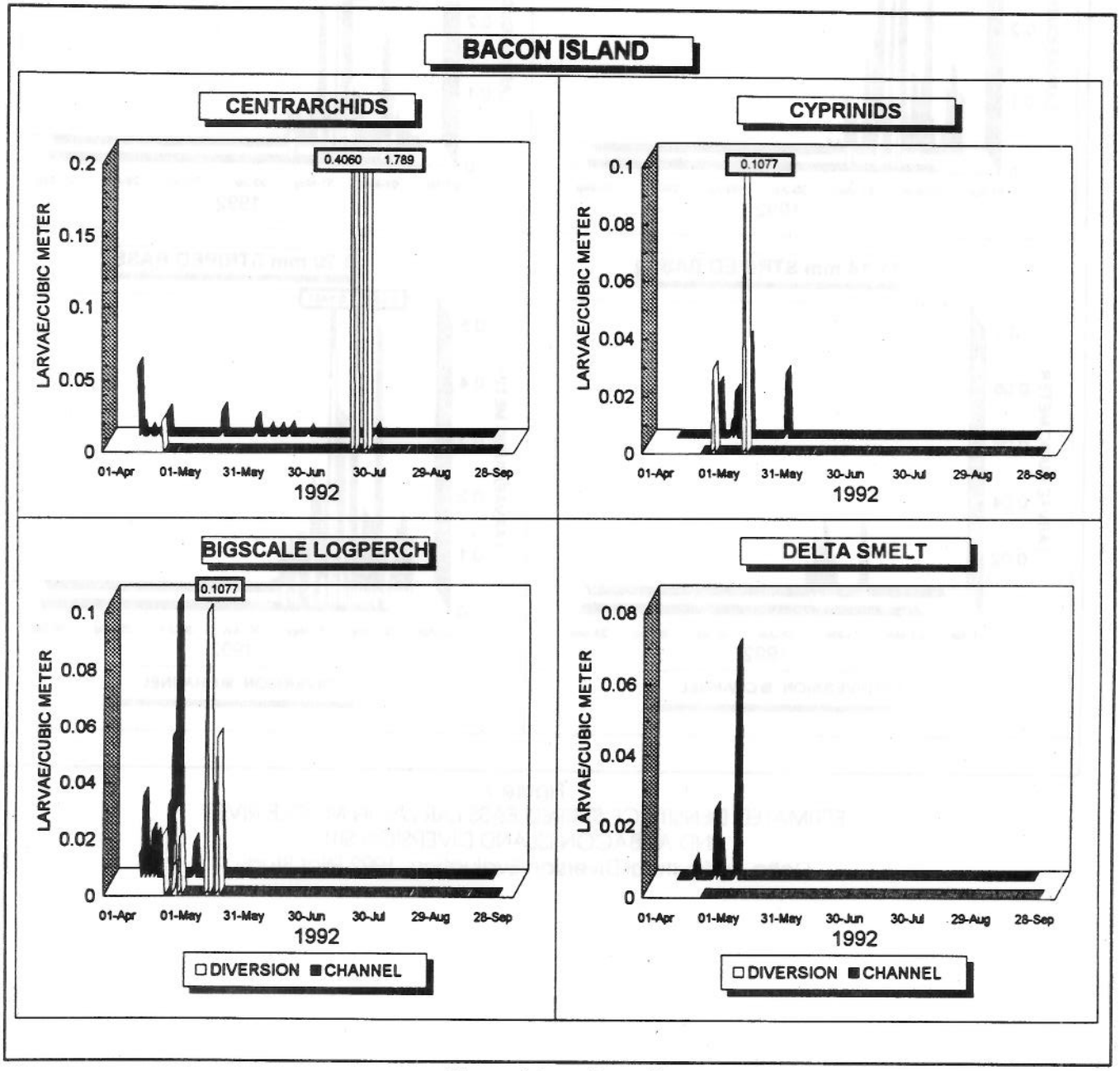

Figure 6 (continued)
ESTIMATED DENSITY OF LARVAE IN MIDDLE RIVER
AND AT BACON ISLAND DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

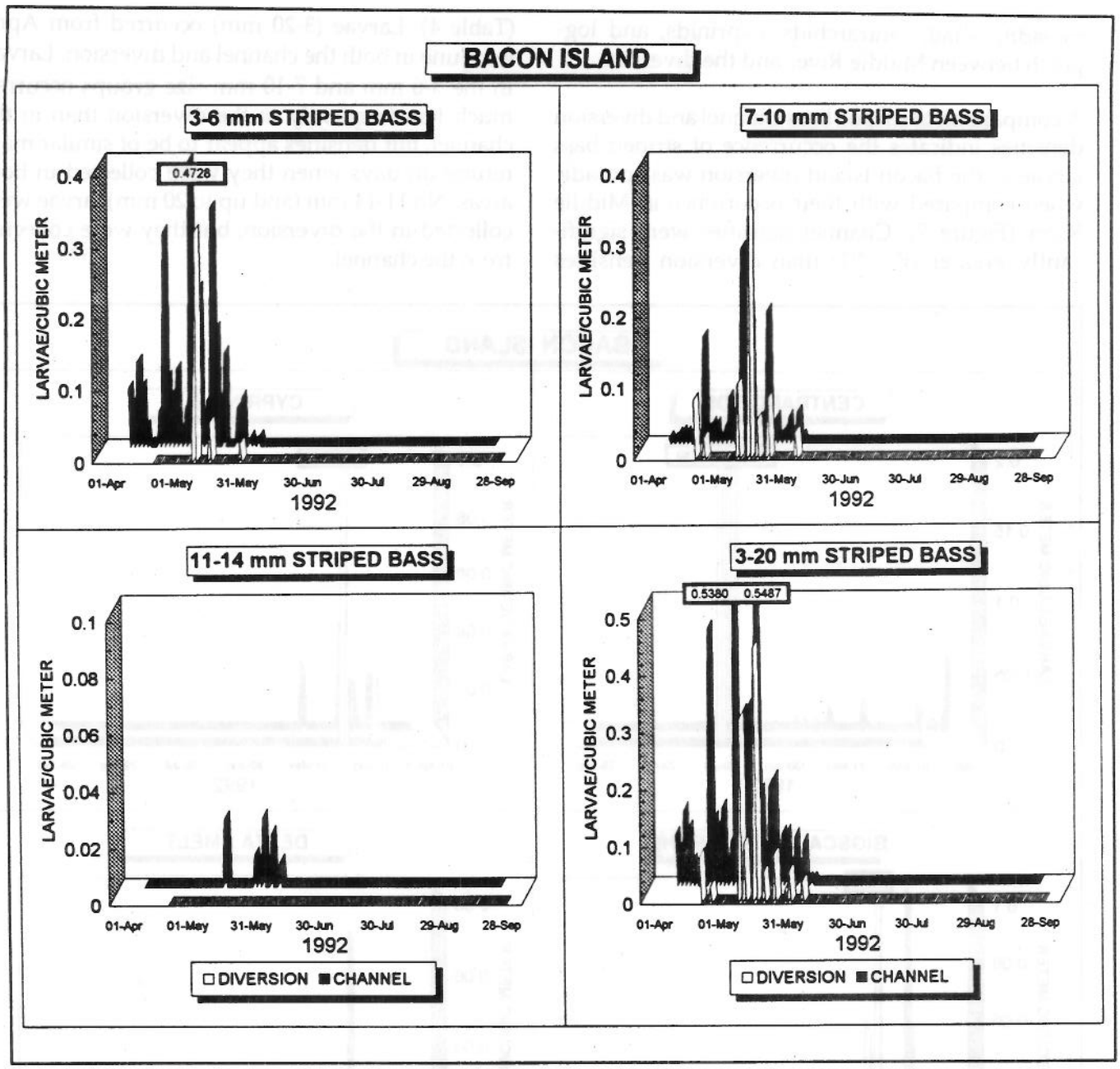

Figure 7
ESTIMATED DENSITY OF STRIPED BASS LARVAE IN MIDDLE RIVER
AND AT BACON ISLAND DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Table 4
PAIRED COMPARISONS OF
EGG AND LARVAL DENSITY IN AGRICULTURAL DIVERSIONS AND ADJACENT DELTA CHANNELS
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Values shown are the significance levels from the Wilcoxon Signed-Ranks Test.
Asterisks denote significance (P<0.05, P<0.01**).*
Blank spaces indicate either zero catch during paired sampling or an insufficient number of paired samples (n<6) to test with nonzero differences.

Species	Bacon Island	McDonald Tract	Naglee Burk	Screen Test
Larvae:				
Chameleon goby	0.000**	0.001**	0.031*	0.027*
Threadfin shad	0.053	0.003**	0.170	0.000**
Prickly sculpin	0.004**			
Striped bass	0.004**			
Centrarchids	1.000	0.477	0.142	0.036*
Bigscale logperch	0.760			
Cyprinids	0.933			
Eggs:				
Threadfin shad				0.208

Abundance and distribution of larval fish in the McDonald Tract diversion in comparison to the adjacent channel (Turner Cut) also appear to vary for some species. Threadfin shad densities were significantly higher (P<0.01) in the diversion than the channel (Figure 8; Table 4). In contrast, chameleon goby were significantly more abundant (P<0.01) in the channel than in the diversion. There was no significant difference in centrarchid density between these two areas (Table 4). The remaining larval species collected in Turner Cut were not collected in the diversion: prickly sculpin, delta smelt, cyprinids, logperch, and striped bass (Tables 2 and 3; Figures 8 and 9).

At the Naglee Burk site, all species except centrarchids were present in Old River before the diversion season. Channel sampling was from February to July, and landside sampling was from May to September. The channel site was downstream and not directly adjacent to the diversion pump, which may account for some catch differences.

During the diversion season, threadfin shad, chameleon goby, and centrarchids occurred over a similar period (May-July) in Old River and in the diversion (Figure 10). There was no significant difference between either threadfin shad or centrarchid densitites in the diversion compared with those in the adjacent channel (Table 4). Chameleon goby densities were significantly higher (P<0.05) in the channel than in the diversion. Prickly sculpin, splittail, inland silverside, and striped bass occurred in Old River before and during the diversion season but were not collected from the diversion (Figures 10 and 11). No delta smelt or longfin smelt were collected at either location. One larval Sacramento sucker was collected from the diversion in early July (Table 2).

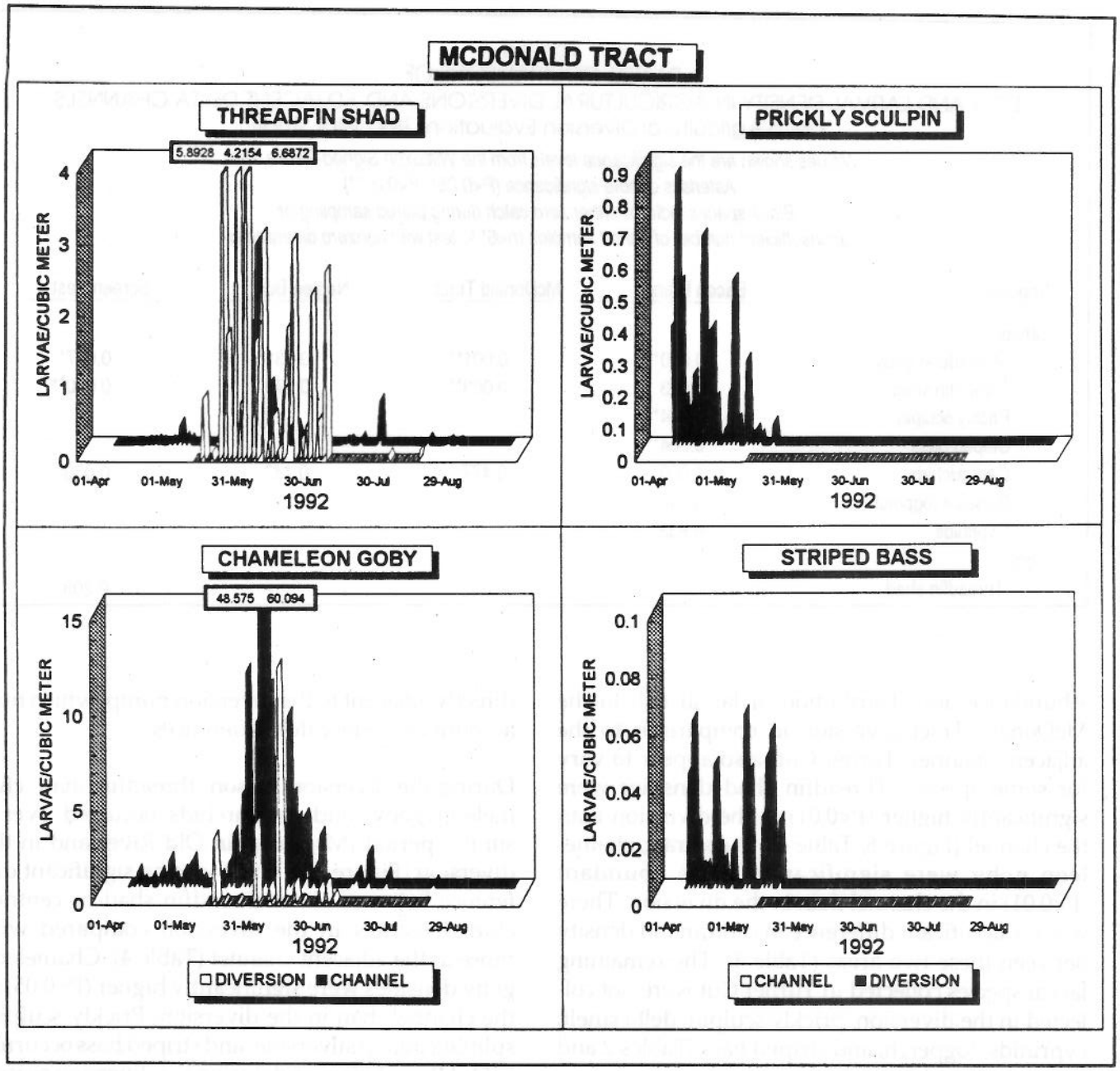

Figure 8
ESTIMATED DENSITY OF LARVAE IN TURNER CUT
AND AT MCDONALD TRACT DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

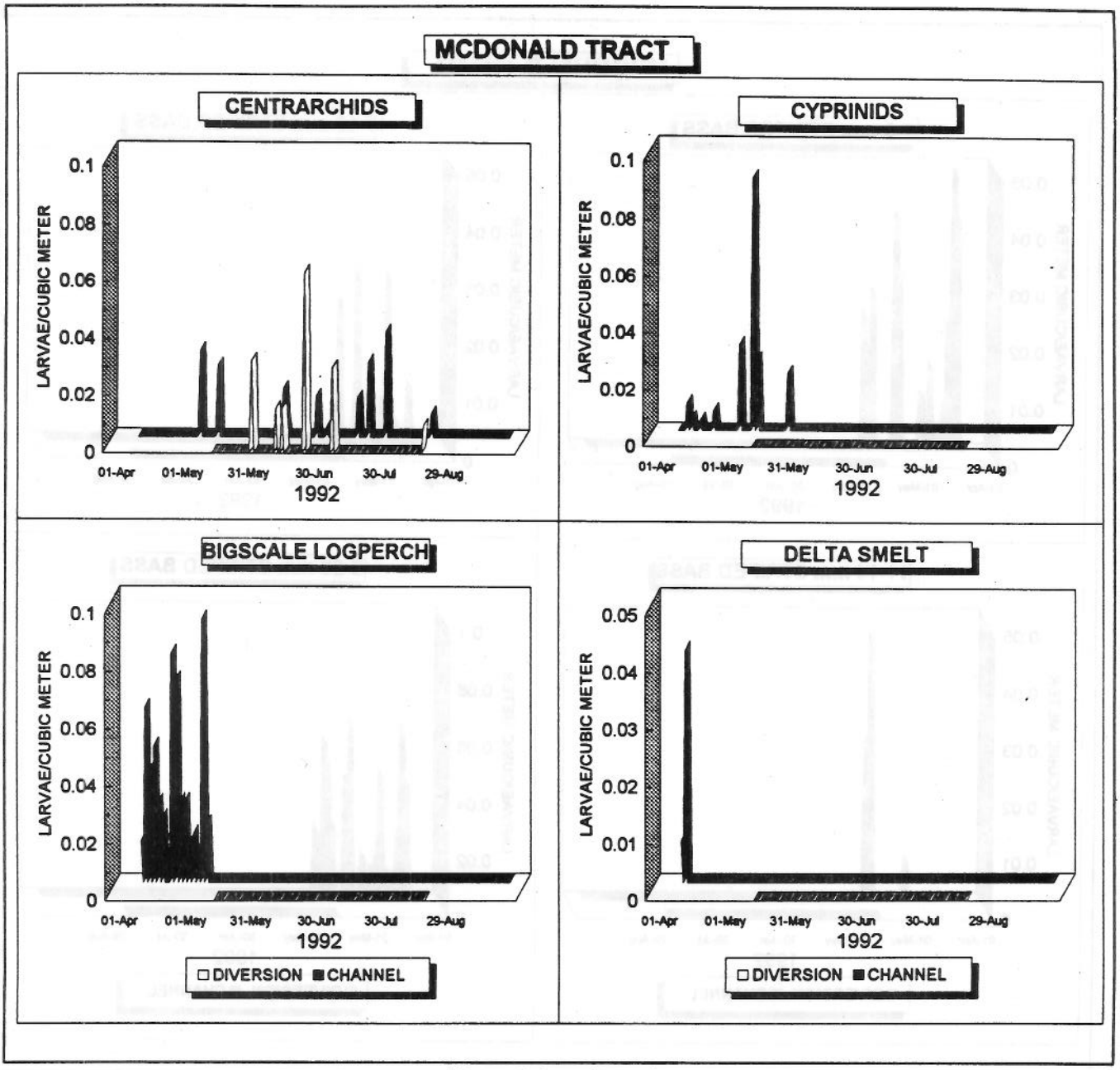

Figure 8 (continued)
ESTIMATED DENSITY OF LARVAE IN TURNER CUT
AND AT MCDONALD TRACT DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

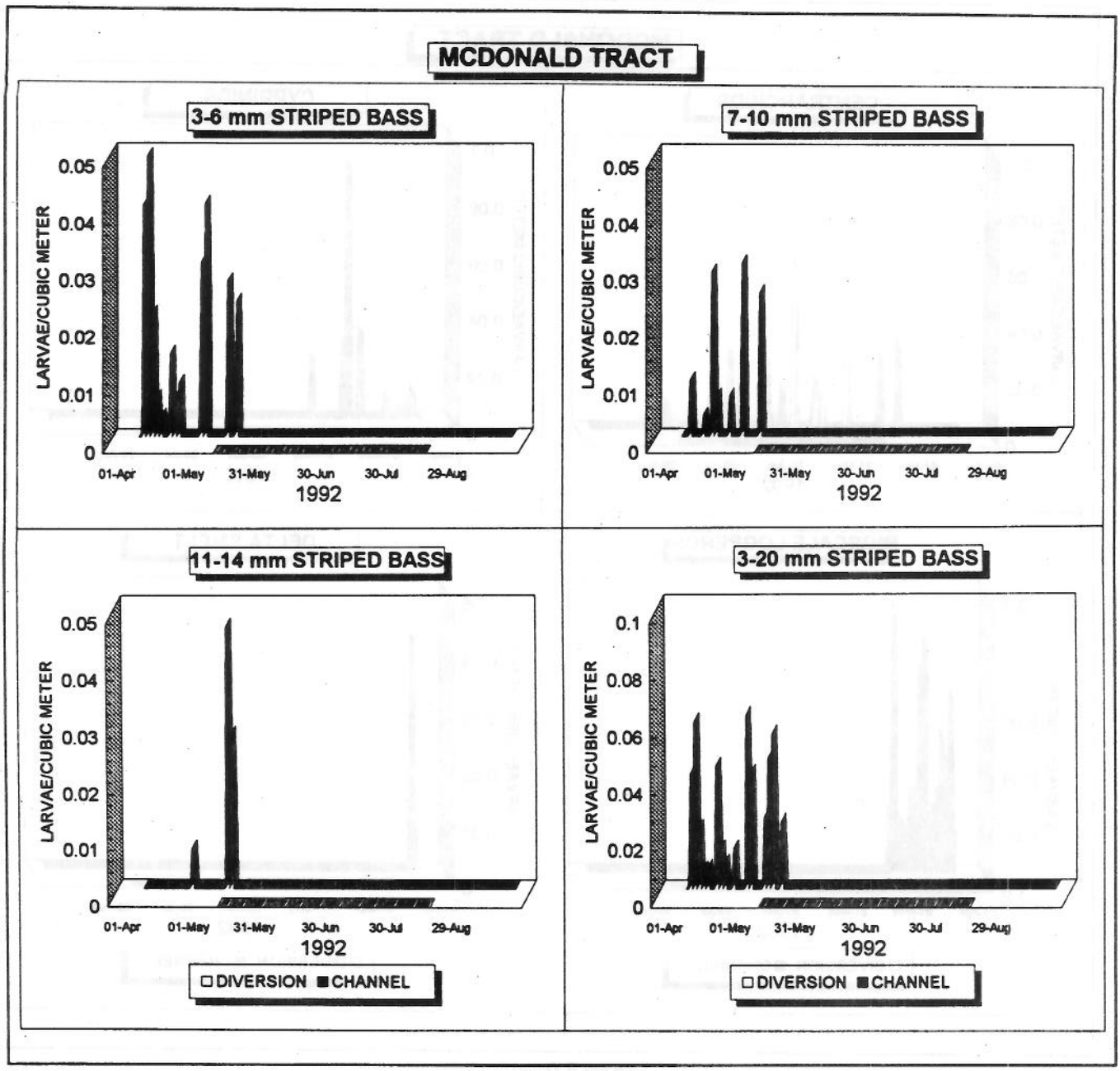

Figure 9
ESTIMATED DENSITY OF STRIPED BASS LARVAE IN TURNER CUT
AND AT MCDONALD TRACT DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

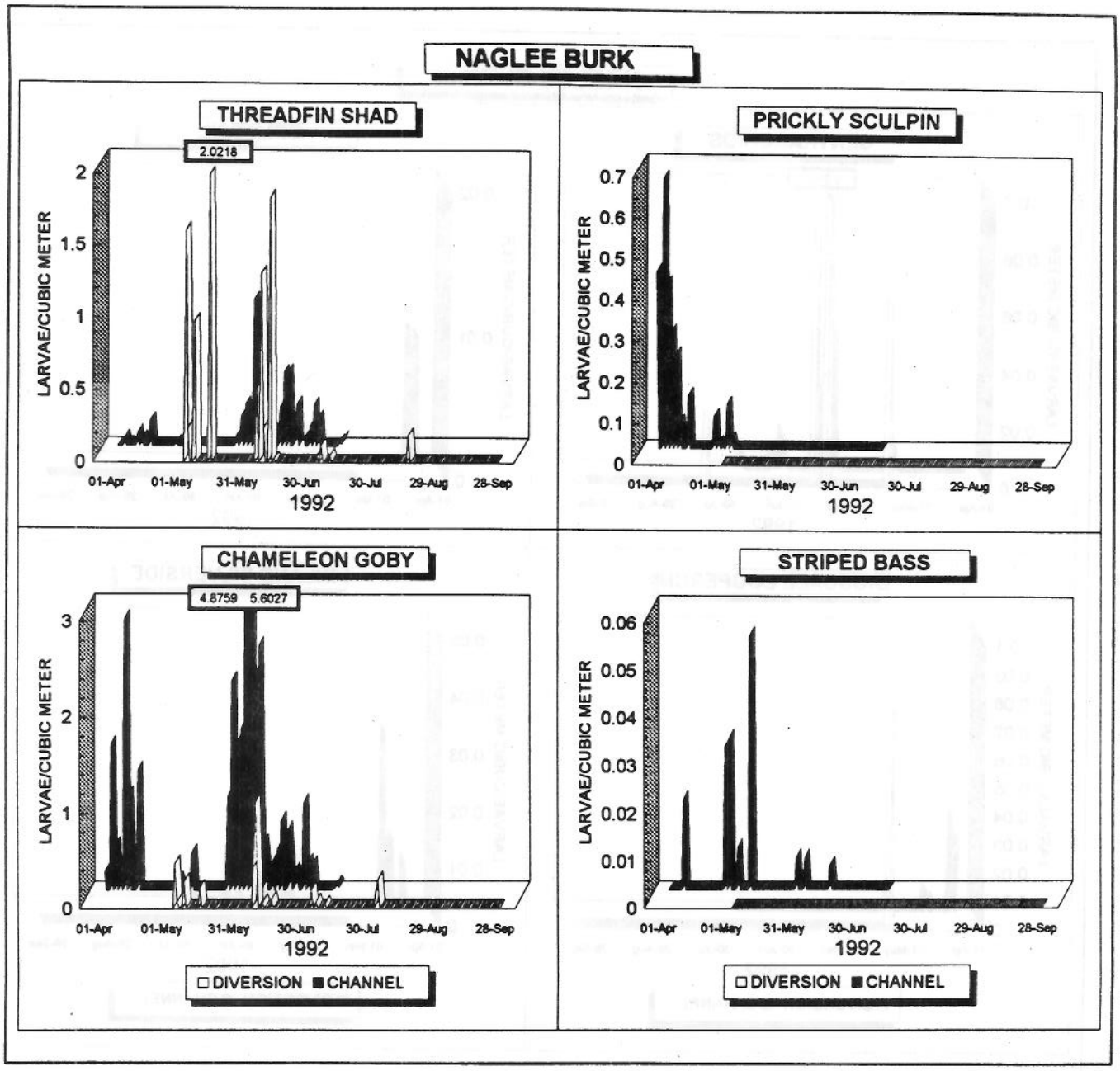

Figure 10
ESTIMATED DENSITY OF LARVAE IN OLD RIVER
AND AT NAGLEE BURK DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

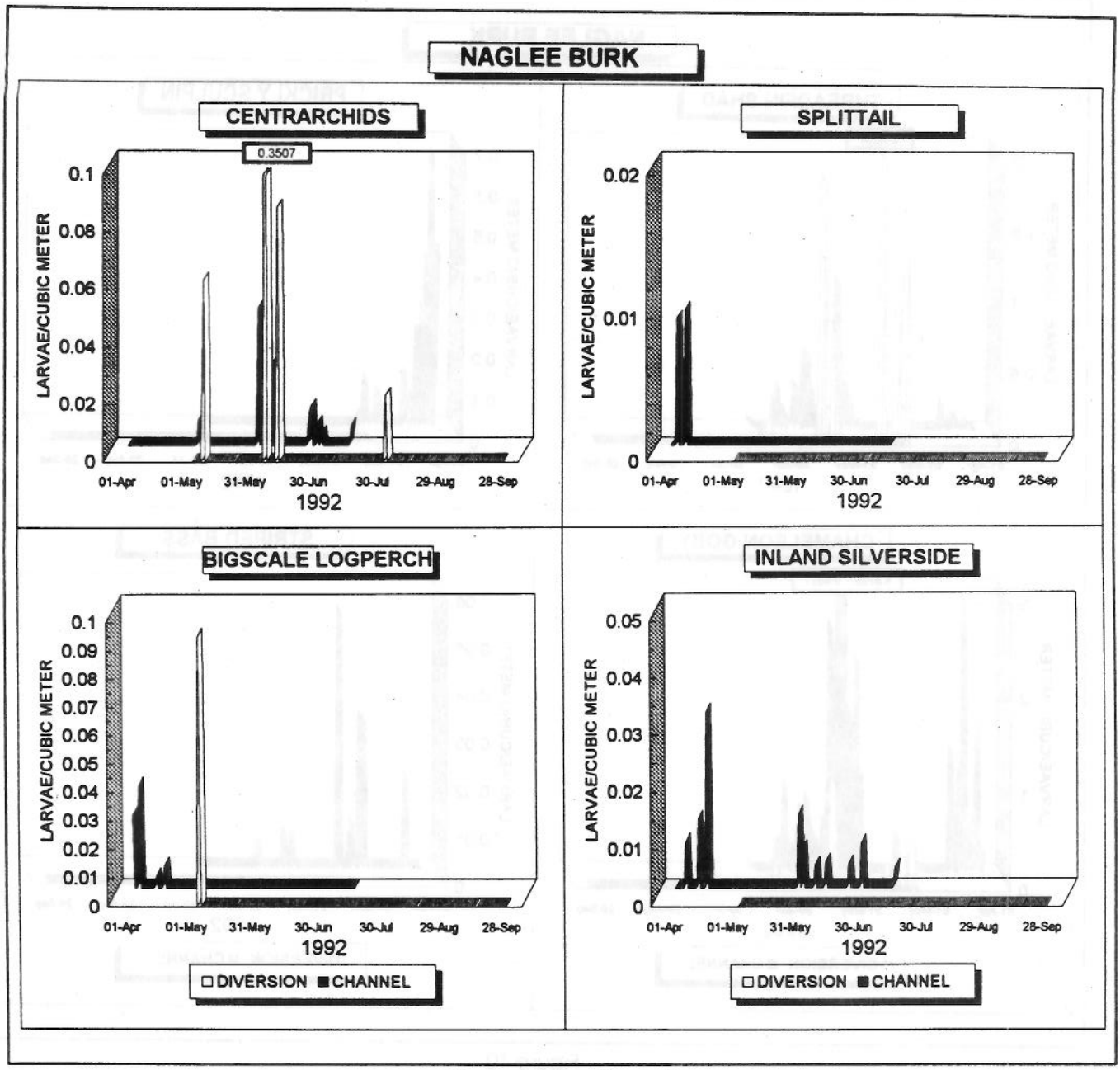

Figure 10 (continued)
ESTIMATED DENSITY OF LARVAE IN OLD RIVER
AND AT NAGLEE BURK DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

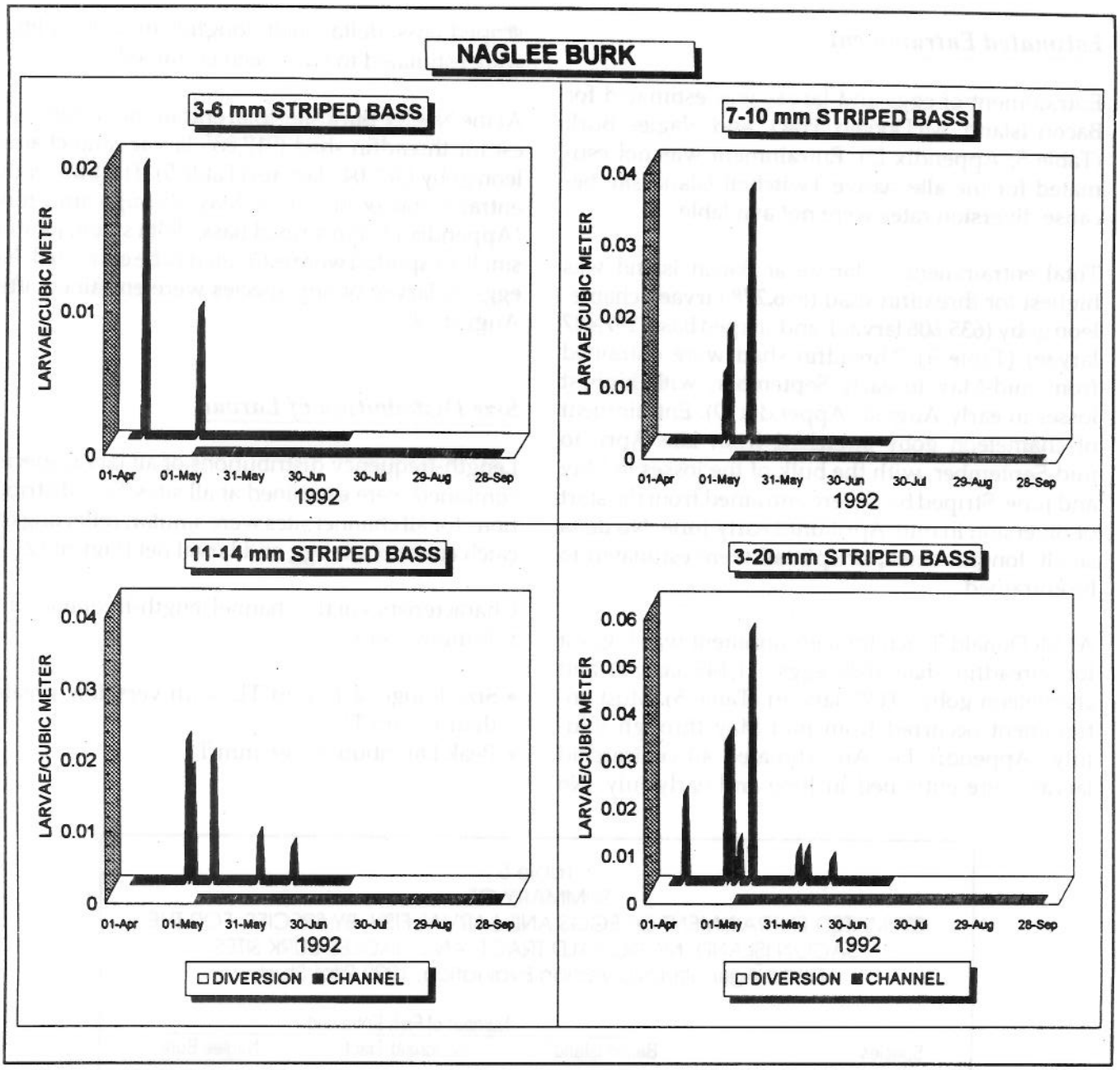

Figure 11
ESTIMATED DENSITY OF STRIPED BASS LARVAE IN OLD RIVER
AND AT NAGLEE BURK DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Estimated Entrainment

Entrainment of eggs and larvae was estimated for Bacon Island, McDonald Tract, and Naglee Burk (Table 5; Appendix D). Entrainment was not estimated for the alternative Twitchell Island site because diversion rates were not available.

Total entrainment of larvae at Bacon Island was highest for threadfin shad (696,278 larvae), chameleon goby (635,606 larvae), and striped bass (197,487 larvae) (Table 5). Threadfin shad were entrained from mid-May to early September, with highest losses in early August (Appendix D). Entrainment of chameleon goby stretched from late April to mid-September, with the bulk of the losses in May and June. Striped bass were entrained from the start of diversion in mid-April until early June. No delta smelt, longfin smelt, or splittail were estimated to be entrained.

At McDonald Tract, total entrainment was highest for threadfin shad (639 eggs; 11,147 larvae) and chameleon goby (9,073 larvae) (Table 5). Most entrainment occurred from mid-May through mid-July (Appendix D). An estimated 40 centrarchid larvae were entrained in June and early July. No striped bass, delta smelt, longfin smelt, or splittail were estimated to have been entrained.

At the Naglee Burk site, total entrainment was highest for threadfin shad (917,885 larvae) and chameleon goby (385,046 larvae) (Table 5). The bulk of the entrainment occurred in May through mid-June (Appendix D). No striped bass, delta smelt, longfin smelt, or splittail were estimated to be entrained. No eggs or larvae of any species were entrained after August 19.

Size Distribution of Larvae

Length-frequency distributions of all larval species combined were examined at all sites. Size distributions for all channel sites were similar, reflecting the catch curve of the egg and larval net (Figure 12).

Characteristics of the channel length-frequency distributions were:

- Size Range: 2-16 mm TL, with very few greater than 16 mm TL.
- Peak Distribution: 3-6 mm TL.

Table 5
SUMMARY OF
ESTIMATED ENTRAINMENT OF EGGS AND LARVAL FISH, BY SPECIES, FOR THE BACON ISLAND, MCDONALD TRACT, AND NAGLEE BURK SITES
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Species	Number of Fish Entrained		
	Bacon Island	McDonald Tract	Naglee Burk
Chameleon goby	635,606	9,073	385,046
Threadfin shad	696,278	11,147	917,885
Prickly sculpin	9,893	0	0
Striped bass	197,487	0	0
Centrarchids	45,141	40	52,790
Bigscale logperch	59,052	0	11,992
Inland silverside	0	0	0
American shad	524	0	0
Cyprinids	37,552	0	27,649
Delta smelt	0	0	0
Sacramento splittail	0	0	0
Sacramento sucker	0	0	24,288
Mosquitofish	0	11	0
Miscellaneous eggs	0	639	27,253

- Chameleon goby dominated the 2-4 mm TL (some 5 mm TL) catch.
- Threadfin shad dominated the 5 mm TL and larger catch.
- Efficiency of the channel gear appears to drop off at 10-12 mm TL and above.

Characteristics of the diversion length-frequency distributions were:

- Size Range: 2-16 mm TL, with a few greater than 16 mm TL.
- Peak Distribution: Bacon 4-6 mm TL; McDonald and Naglee Burk, bimodal distribution, 3-4 mm TL (mostly chameleon goby) and 6-10 mm TL (mostly threadfin shad).

- Chameleon goby dominated the 2-4 mm TL (some 5 mm TL) catch.
- Threadfin shad dominated the 5 mm TL and larger catch.

A comparison of the length-frequency distributions for channel and diversion catches at Bacon Island, McDonald Tract, and Naglee Burk indicate length distributions were similar for these sites (Figure 12), varying primarily in magnitude, most likely as a reflection of the differences in larval abundance between sites. The channel distributions were composed largely of chameleon goby, threadfin shad, and prickly sculpin, whereas prickly sculpin were lacking in all diversions. At Bacon Island, both channel and diversion distributions included a moderate abundance of striped bass.

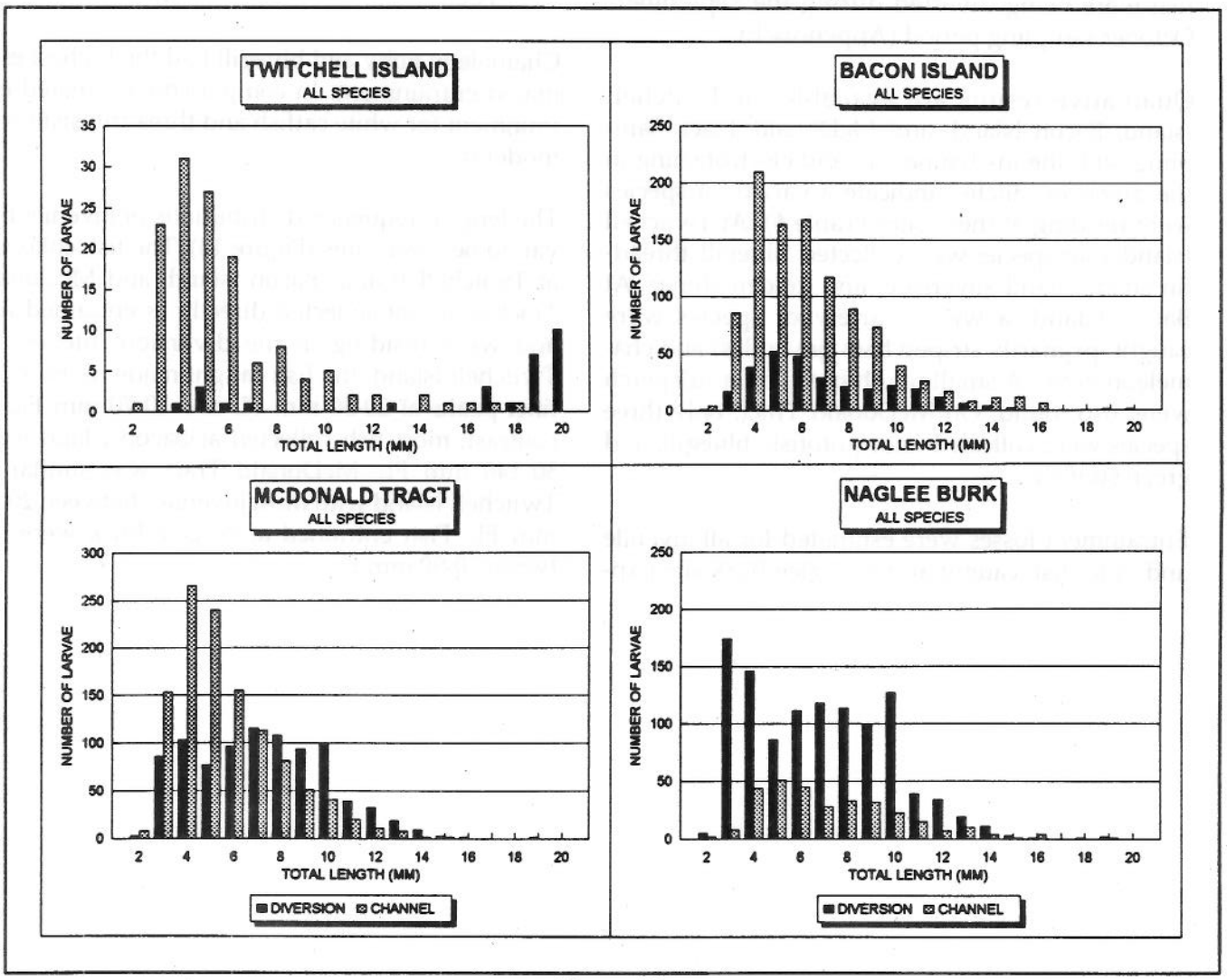

Figure 12
LENGTH-FREQUENCY DISTRIBUTION OF ALL 2-20 MM TL FISH FOR ALL DIVERSION AND CHANNEL SITES
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Juveniles and Older Fish

Entrainment of juvenile and older fish could not be estimated for Twitchell Island, Bacon Island, or McDonald Tract. The initial sampling method, using a winged fyke-type net fished in the diversion channel, proved unreliable for calculating catch per unit effort and estimating entrainment. Gear was tested at Bacon Island using a bag-net to cover the mouth of the siphon and sample the total diversion flow while the fyke-net was fished. No fish were caught in the bag-net, but fish were still being caught in the in-channel fyke-net, indicating fish already residing in the diversion ditch were those being caught. Results from additional sampling with the bag-net only for late September through October indicated no fish were being diverted during the September-October sampling period (Appendix E).

Qualitative results are available for Twitchell Island, Bacon Island, and McDonald Tract. Sampling with the in-channel net and electrofishing in the diversion ditches indicate a variety of species were residing at these sites (Table 6). At Twitchell Island, four species were collected: bluegill, threadfin shad, inland silverside, and golden shiner. At Bacon Island, a wider variety of species were caught, primarily striped bass (juveniles) and chameleon goby. A smallmouth bass and a tuleperch were also found. On McDonald Tract, only three species were collected: mosquitofish, bluegill, and green sunfish.

Entrainment losses were estimated for all juvenile and older fish caught at the Naglee Burk site (Appendix E). At this site, the diversion ditch dried out between diversion periods, thus ensuring that fish caught had been recently diverted. From August through October, only 24 fish and 5 species were caught (Table 6). Entrainment was estimated for the following species caught:

Species	Estimated Number of Fish Entrained
Chameleon goby	555
Threadfin shad	127
Bluegill	341
Mosquitofish	72
White catfish	182
Total	1,277

Chameleon goby and bluegill had the highest estimated entrainment. In comparison, estimated entrainment for white catfish and threadfin shad was moderate.

The length-frequency distributions of juvenile fish varied between sites (Figure 13). The fish collected at Twitchell Island, Bacon Island, and McDonald Tract were not collected directly as entrained fish and were residing in the diversion ditches. At Twitchell Island, the fish caught made up two distinct peaks at 20-30 mm FL and 50-70 mm FL. In contrast, most fish collected at Bacon Island were 50-140 mm FL. McDonald Tract was similar to Twitchell Island with most juveniles between 20-50 mm FL. Fish entrained at Naglee Burk were between 20-90 mm FL.

Table 6
SPECIES CATCH SUMMARY OF JUVENILE AND OLDER FISH COLLECTED
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Blank spaces indicate zero catch.
NS indicates the site was not sampled for juvenile fish.

	Number of Fish							
	Diversion Sites				Channel Sites (Tow-Net)			
Species	1 Twitchell Island[1]	2 Bacon Island	3 McDonald Tract	4 Naglee Burk	934 Twitchell Island	932 Bacon Island	933 McDonald Tract	93 Naglee Burk
Chameleon goby		81		9				NS
Threadfin shad	21	4		3		1		NS
Prickly sculpin		3						NS
Striped bass		184			3	1		NS
Bluegill	200	1	2	7				NS
Green sunfish			2					NS
Bigscale logperch		9						NS
Inland silverside	3				7	1		NS
American shad								NS
Cyprinids								NS
Delta smelt								NS
Sacramento splittail								NS
Sacramento sucker								NS
Mosquitofish			27	2				NS
White catfish		1		3	1			NS
Yellowfin goby		2			1			NS
Smallmouth bass		1						NS
Tule perch		1						NS
Golden shiner	1							NS
Total Fish	**225**	**228**	**31**	**24**	**12**	**3**	**0**	**NS**

1 Alternative site on Sevenmile Slough.

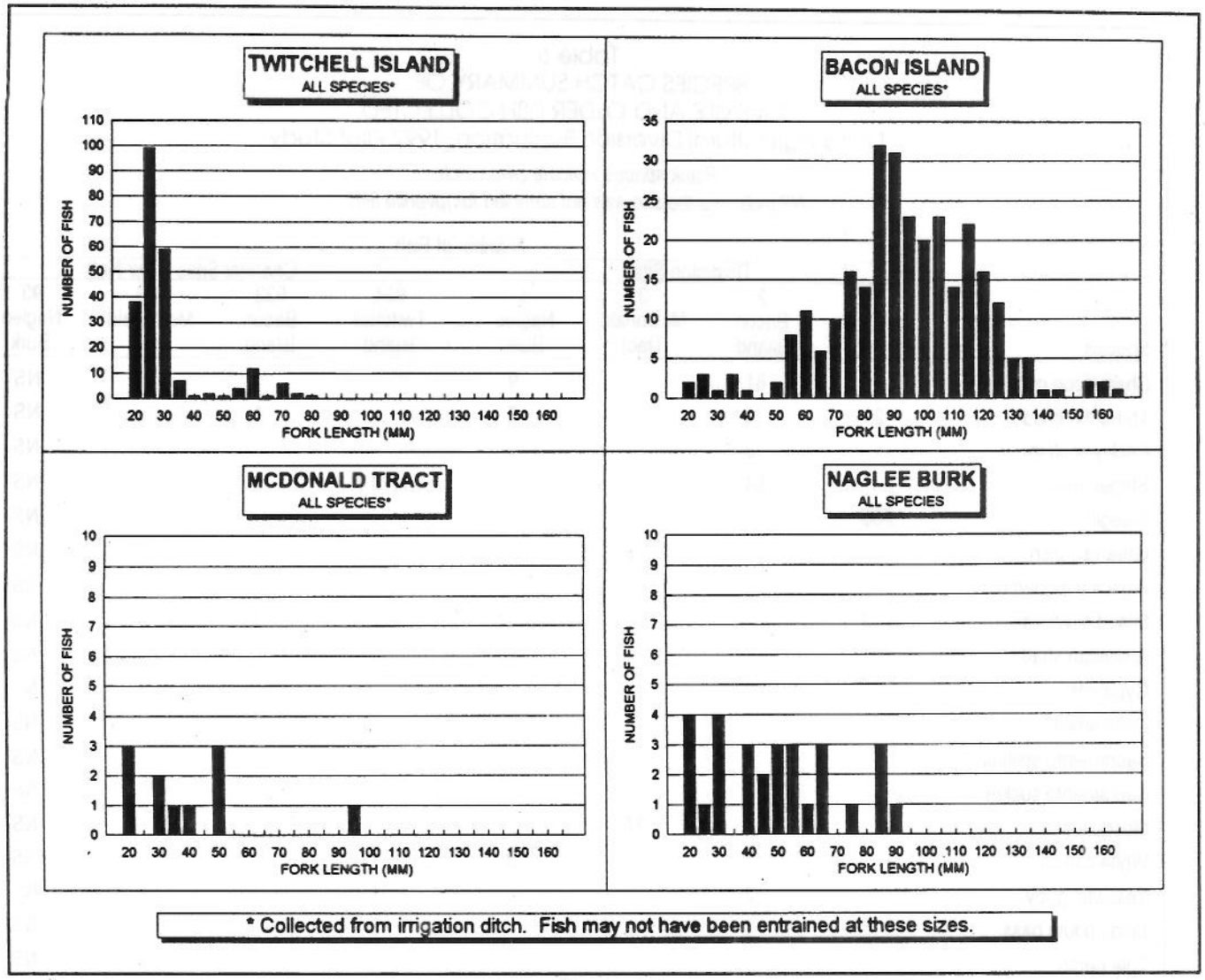

Figure 13
LENGTH-FREQUENCY DISTRIBUTION OF ALL 20-165 MM TL FISH FOR ALL DIVERSION SITES
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

McDonald Tract Fish Screen Test

Due to unreliable results from the juvenile gear, only data obtained from the egg and larval sampling gear were usable for testing the effectiveness of the fish screen. Larvae and eggs of threadfin shad and larvae of chameleon goby were the only species caught under both screened and unscreened conditions (Figure 14). Larval centrarchids were caught only under unscreened conditions.

Test results indicate no significant difference between the unscreened and screened catch densities of threadfin shad eggs (Table 4). However, screened densities were significantly lower than unscreened densities for larval threadfin shad ($P<0.01$), chameleon goby ($P<0.05$), and centrarchids ($P<0.05$). Results indicate that at times chameleon goby can be entrained at moderate to high densities under screened conditions. However, these were very small larvae (3-4 mm TL).

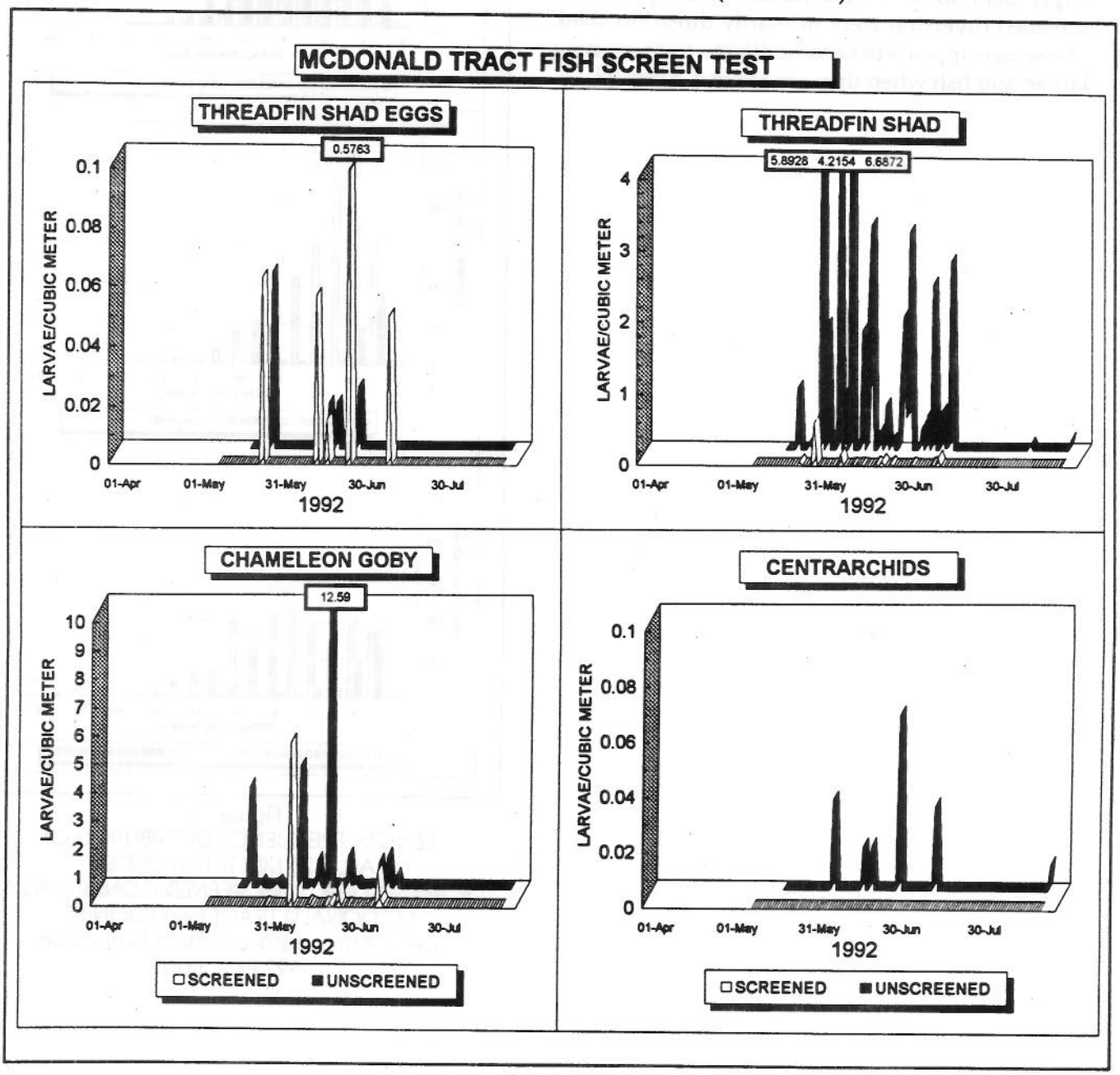

Figure 14
ESTIMATED DENSITY OF LARVAE UNDER SCREENED AND UNSCREENED CONDITIONS AT THE MCDONALD TRACT DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

The size distribution of larvae was compared under screened and unscreened conditions and with the channel distribution (Figure 15). The distribution for the unscreened diversion is similar to that for the channel, except over the 3-6 mm size range. Under screened conditions, the diversion appears to have entrained mostly very small larvae. For the most part, these small larvae were newly or recently hatched chameleon gobies, which could account for density peaks under screened conditions. Larvae larger than about 5 mm TL diverted by the unscreened diversion were primarily threadfin shad. The screen appears to become effective at screening larvae and fish when they are about 4-5 mm TL.

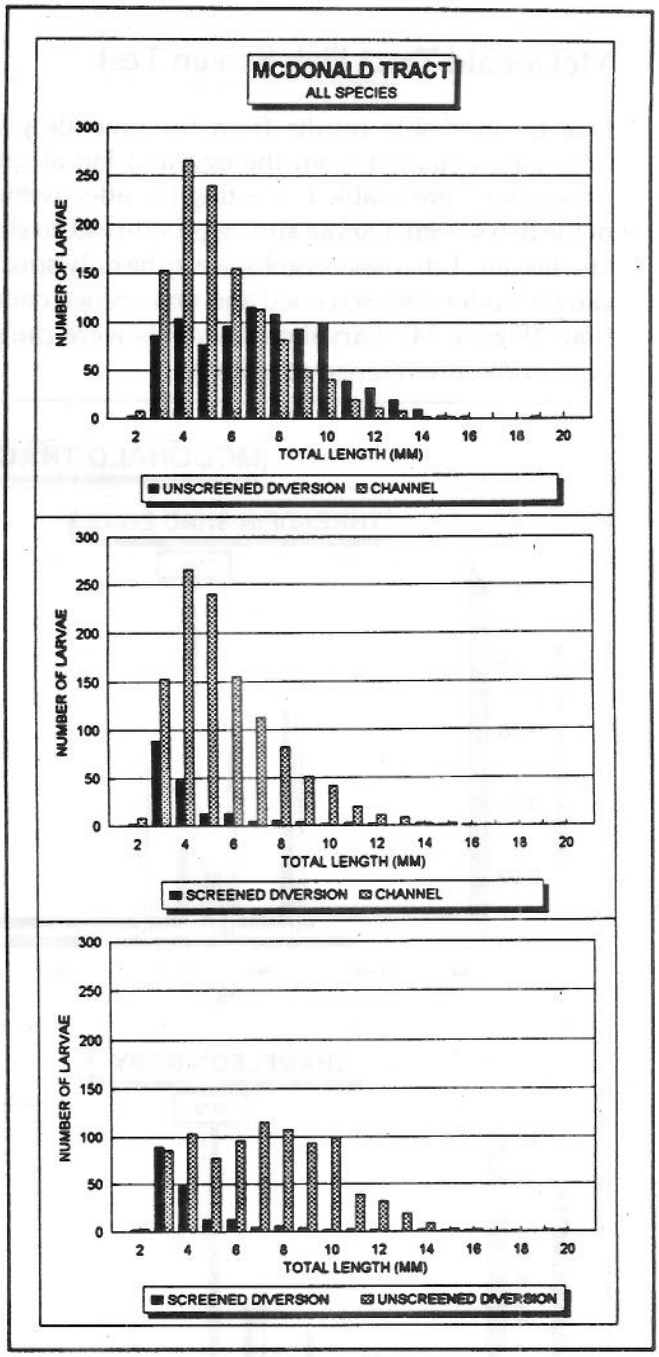

Figure 15
LENGTH-FREQUENCY DISTRIBUTION OF ALL 2-20 MM TL FISH UNDER SCREENED AND UNSCREENED CONDITIONS AT MCDONALD TRACT DIVERSION SITE
Delta Agricultural Diversion Evaluation, 1992 Pilot Study

Discussion

The degree of vulnerability to entrainment appears to vary with species and life stage. Entrainment appears to depend largely on life stage, seasonal occurrence, abundance, and distribution of a species in the adjacent channel and on operations of the diversion (seasonal timing, frequency and duration, and flow and volume). Tidal influence and time of day (day *vs* night) could also affect entrainment, but those factors were not investigated in this pilot study.

Results from sampling in the Delta agricultural diversions and adjacent channels indicate that eggs, larvae, juveniles, and older fish are susceptible to entrainment into the diversions. In general, eggs and larvae are the life stages most vulnerable to entrainment. Species whose life stages use nearshore areas for spawning and rearing are particularly vulnerable, because intakes of agricultural siphons and pumps are usually located off levees in these areas. Seasonal timing of diversions is important in that high volumes of diversions may coincide with periods of high abundance of egg and larval stages, resulting in high entrainment. For example, Bacon Island had high diversion volumes in late April through mid-June, when striped bass larvae were present and abundant. The impact of diversions would be lower later in the season, when fish are larger and less vulnerable to entrainment.

Based on results from this study, eggs of broadcast spawners, such as threadfin shad, are susceptible to entrainment. Although the sample size was too small ($n<6$ paired samples with nonzero differences) to statistically test whether there was a difference between channel and diversion densities, threadfin shad eggs were entrained at McDonald Tract and Naglee Burk but were not found in any of the channel samples. Threadfin shad spawn in areas of shallow water with vegetation below the surface[16], so their eggs and larvae are less likely to be collected by present sampling methods. This type of habitat was present at the both the McDonald Tract and Naglee Burk diversions.

No conclusion can be reached on the vulnerability of striped bass eggs to agricultural diversions. Striped bass eggs were collected only off Twitchell Island, on the San Joaquin River. No diversion samples could be obtained at the siphon at this site. However, Allen[17] found that concentrations of striped bass eggs in Sherman Island diversions did not vary statistically from and were of the same general magnitude as those in the adjacent San Joaquin River.

Larval fish were the predominant life stage entrained and appear to be the most vulnerable to these diversions. Generally, they are more abundant than juveniles or older fish due simply to the impact of mortality on a population before they can reach the later stages. Larvae are also poor swimmers and, if near an intake, would probably be unable to avoid entrainment. Species collected in the agricultural diversions were usually a subset of larval species in adjacent channels.

Based on comparisons between diversion and channel abundance, the larval species most susceptible to entrainment appear to be threadfin shad, centrarchids, cyprinids, and logperch. Statistically, diversion densities consistently did not vary from channel densities. However, at McDonald Tract, threadfin shad had higher densities in the diversion than in the adjacent channel. The siphon intake at this site is probably in or near an area of threadfin shad spawning.

16 J.C.S. Wang. *Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Stages.* Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 9. Department of Water Resources. 1986.

17 D.H. Allen, 1975. Previously cited.

Chameleon goby, striped bass, and prickly sculpin appear to be less vulnerable to diversions than their channel densities would indicate. They were abundant in the channel but, except for chameleon goby, generally not in the diversions. These species consistently had diversion densities significantly lower than their channel densities. However, Allen[18] found that concentrations of striped bass larvae in Sherman Island diversions did not vary statistically and were of the same general magnitude as those in the adjacent San Joaquin River.

In general, chameleon goby, threadfin shad, and centrarchids were the most abundant species entrained by the diversions. Threadfin shad and chameleon goby had the highest entrainment at all sites and were also abundant in the adjacent channels. These species may be vulnerable to entrainment due to their preference for spawning or rearing habitat in shallow-water, edge-type habitat with cover.

Striped bass were entrained only at Bacon Island, from April 20 to June 9. Total entrainment was 197,487 larvae. In comparison, total entrainment was 40 to 60 times higher at the SWP (7,948,000 larvae) and CVP (11,271,000 larvae).[19] It would require about 50 agricultural diversions with volume and operations similar to the Bacon Island siphon, and in an area of similar striped bass density, to equal the magnitude of losses at the SWP or CVP. With about 1,850 agricultural diversions in the Delta, at least 50 are likely similar to the one at Bacon Island.

Results from this pilot study provide no evidence of delta smelt, longfin smelt, or splittail larval entrainment. Delta smelt and splittail abundances were low and catches were infrequent in the channels. No delta smelt or splittail were caught in the diversions, and no longfin smelt were collected in either area. The infrequent occurrence of these species in the areas and diversions under study indicates these may not be the best sites for focusing on diversion impacts to these species.

Entrainment estimates for juvenile and older fish were possible only at Naglee Burk, due to gear problems at the other sites. Chameleon goby, threadfin shad, bluegill, mosquitofish, and white catfish were entrained at Naglee Burk. They ranged from 20 to 90 mm FL.

For the screen test at McDonald Tract, test results were usable for eggs and larvae only. The fish screen appears to be effective in reducing entrainment of 4-5 mm TL and larger larvae. However, the effects of screen impingement on the larvae are not known. Small (3-4 mm TL) chameleon goby larvae were not screened effectively. Threadfin shad larvae (5 mm TL and larger) were screened effectively.

Characteristics of larval length-frequency distribution were similar between channel and diversion catches. The size range for both areas was 2-16 mm TL, with very few greater than 16 mm TL. Efficiency of the gear appears to decline at 10-12 mm TL and above. The peak distribution in the channel was 3-6 mm TL, which was similar to the diversion. However, McDonald and Naglee Burk had bimodal distributions at 3-4 mm TL (mostly chameleon goby) and 6-10 mm TL (mostly threadfin shad).

Problems Encountered

Meters on Diversions

- For most of the season at Naglee Burk, the rate and amount of diversions had to be estimated based on diversions in September. Due to coordination difficulties between the ditch tender and the company installing the meter, the meter was not installed until September 4.
- At Bacon Island, flowmeters malfunctioned several times in late summer due to vegetation and fishing line becoming entangled on the propellers.
- Diversion flows (cfs) were often too high for the range of the flowmeter and, above that range, had to be estimated.

18 D.H. Allen, 1975. Previously cited.
19 S.A. Spaar, 1993. Previously cited.

Sampling Problems

- At times, ditch flows were so low it was difficult to fish the egg and larval net. A net meter with a low-flow propeller is needed.
- The juvenile nets were not received until late June.
- The in-channel juvenile sampling method did not provide usable data for Bacon Island or McDonald Tract.
- Available gear for sampling juveniles in adjacent channels (tow-net) was not appropriate for the period of use, because the juvenile fish had grown too large to be susceptible to the gear. A midwater or otter trawl would have been more effective.
- The channel directly adjacent to the Naglee Burk site is inaccessible to the survey boat due to shallows. Station 93 was inaccessible after the temporary barrier was installed.
- On Twitchell Island, the siphon to be sampled did not divert until August — and then for only 2 weeks. We were not notified when diversion began and were not able to get to the siphon due to major levee repairs.

Preparation and Analysis of Data

- Time available for staff to prepare and analyze the data was not sufficient to produce a report before the next sampling season.

Recommendations

- For juvenile sampling, use bag or fyke-type nets that completely cover the end of the diversion outfall.
- Increase juvenile sampling effort at the diversion and in adjacent channels. For channel sampling, use a trawl, tow-net, beach seine, or electrofishing as appropriate for the site.
- Decrease egg and larval sampling effort to once or twice a week at the diversion and in adjacent channels. Discontinue egg and larval sampling in mid-July, similar to other Delta egg and larval studies. This will also allow the laboratory to provide all results in time for the annual monitoring report to the U.S. Army Corps of Engineers.
- Discontinue sampling before October 31 or extend the due date for the Corps of Engineers monitoring report.
- Locate dependable sites near known areas of abundance for delta smelt and native species to assess impacts to these fishes.

Additional Data Needs

- Landside and channel data on juvenile and older fish covering the entire diversion season.
- Complete data on amount and duration of diversions, including when diversions begin and end.

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Appendix A

ESTIMATED DAILY DIVERSION AT STUDY SITES

Delta Agricultural Diversion Evaluation
1992 Pilot Study

Appendix A. ESTIMATED DAILY DIVERSION (acre-feet) AT STUDY SITES FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

BACON ISLAND

VOLUME DIVERTED
(Acre-Feet)

DAY	APR	MAY	JUN	JUL	AUG	SEP	OCT
1	0	25.19	32.05	6.84	4.51	10.91	3.77
2	0	25.19	32.05	6.84	4.51	10.91	3.14
3	0	25.19	31.72	7.37	4.51	10.91	3.14
4	0	23.21	31.72	7.37	4.51	10.91	3.14
5	0	23.21	31.65	7.37	12.50	10.91	3.25
6	0	21.43	31.65	9.68	12.50	10.91	4.38
7	0	21.43	31.65	6.57	12.50	10.91	4.38
8	0	21.61	31.65	6.57	12.50	10.91	4.38
9	0	21.61	32.81	6.51	12.50	10.91	4.38
10	0	21.61	32.81	5.02	12.50	10.91	4.38
11	0	22.93	25.04	5.02	12.50	10.91	4.38
12	0	28.51	31.48	5.02	12.50	10.91	4.38
13	0	53.74	31.48	13.41	12.50	10.91	4.38
14	0	53.74	31.48	13.41	12.50	10.91	4.38
15	0	53.74	28.78	15.47	12.50	10.91	5.81
16	0	53.74	28.78	15.47	12.50	12.74	4.45
17	0	53.74	21.52	15.67	12.50	12.74	4.45
18	0	50.51	21.52	15.67	12.50	12.74	4.45
19	0	50.51	18.48	15.67	12.50	12.74	6.57
20	25.19	50.51	18.48	9.74	16.46	12.74	5.61
21	25.19	50.51	18.48	9.59	16.46	10.71	6.57
22	25.19	29.49	17.06	10.49	16.46	11.13	6.79
23	25.19	29.49	17.49	10.01	16.46	9.71	5.55
24	25.19	29.49	16.14	10.01	19.83	7.02	0
25	25.19	29.49	15.81	10.01	19.76	7.02	0
26	25.19	30.59	15.81	10.01	12.62	7.02	0
27	25.19	30.73	15.81	10.01	11.90	7.02	0
28	25.19	31.65	15.81	8.00	11.90	5.81	0
29	25.19	31.65	5.11	8.00	11.90	4.52	0
30	25.19	31.65	5.11	4.51	11.90	4.10	0
31		31.65		4.51	11.90		0
TOTAL	277.09	1057.67	719.39	289.81	383.02	301.40	106.11

GRAND TOTAL 3134.50

Appendix A. (Cont.) ESTIMATED DAILY DIVERSION (acre-feet) AT STUDY SITES FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

MCDONALD ISLAND UNSCREENED DIVERSIONS

VOLUME DIVERTED
(Acre-Feet)

DAY	APR	MAY	JUN	JUL	AUG	SEP	OCT
1	*	0	0.16	0.22	0	*	*
2	*	0	0	0	0	*	*
3	*	0	0.25	0.25	0	*	*
4	*	0	0	0	0	*	*
5	*	0	0.13	0	0.14	*	*
6	*	0	0	0.42	0.18	*	*
7	*	0	0	0.57	0	*	*
8	*	0	0	0.25	0	*	*
9	*	0	0.16	0.24	0	*	*
10	*	0	0	0	0	*	*
11	*	0	0.26	0	0	*	*
12	*	0	0.24	0	0	*	*
13	*	0	0	0	0	*	*
14	*	0.01	0	0	0	*	*
15	*	0	0.15	0	0	*	*
16	*	0	0	0	0	*	*
17	*	0	0.21	0	0	*	*
18	*	0.18	0	0	0	*	*
19	*	0	0.27	0	0.23	*	*
20	*	0	0	0	0	*	*
21	*	0	0	0	0	*	*
22	*	0.11	0.32	0	0	*	*
23	*	0	0.17	0	0	*	*
24	*	0	0.37	0	0	*	*
25	*	0	0.18	0	0	*	*
26	*	0.13	0	0	*	*	*
27	0	0.18	0	0	*	*	*
28	0	0.15	0	0	*	*	*
29	0	0	0.23	0	*	*	*
30	0	0	0.18	0	*	*	*
31		0		0	*		*
TOTAL	0.00	0.76	3.27	1.94	0.56	0.00	0.00
GRAND TOTAL							6.52

* Diversions unknown, monitoring period 4-27-92 to 7-25-92.

Appendix A. (Cont.) ESTIMATED DAILY DIVERSION (acre-feet) AT STUDY SITES FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

MCDONALD ISLAND SCREENED DIVERSIONS

VOLUME DIVERTED (Acre-Feet)

DAY	APR	MAY	JUN	JUL	AUG	SEP	OCT
1	*	0	0.24	0.21	0	*	*
2	*	0	0	0	0	*	*
3	*	0	0.14	0.25	0	*	*
4	*	0	0	0	0	*	*
5	*	0	0.24	0	9.53	*	*
6	*	27.40	0	0.36	22.57	*	*
7	*	0	0	0.29	22.57	*	*
8	*	0	0	24.18	22.57	*	*
9	*	0	0.38	15.65	22.57	*	*
10	*	0	0	0	22.57	*	*
11	*	0	0.19	0	0	*	*
12	*	0	0.16	0	0	*	*
13	*	0	0	0	0	*	*
14	*	0	0	0	0	*	*
15	*	0	0.20	0	0	*	*
16	*	0	0	0	0	*	*
17	*	0	0.14	0	0	*	*
18	*	0.23	0	0	0	*	*
19	*	0	0.14	0	0.49	*	*
20	*	0	0	0	0	*	*
21	*	0	0	0	0	*	*
22	*	0.22	0.19	0	0	*	*
23	*	0	0.27	0	0	*	*
24	*	0	0.10	0	0	*	*
25	*	0	0.29	0	0	*	*
26	*	0.16	0	0	*	*	*
27	0	0.10	0	0	*	*	*
28	0	0.20	0	0	*	*	*
29	0	0	0.10	0	*	*	*
30	0	0	0.19	0	*	*	*
31		0		0	*		*
TOTAL	0.00	28.30	2.97	40.94	122.88	0.00	0.00
GRAND TOTAL							195.10

* Diversions unknown, monitoring period 4-27-92 to 7-25-92.

Appendix A. (Cont.) ESTIMATED DAILY DIVERSION (acre-feet) AT STUDY SITES FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

NAGLEE BURK

VOLUME DIVERTED*
(Acre-Feet)

DAY	APR	MAY	JUN	JUL	AUG	SEP	OCT
1	0	0	0	0	0	0	39.89
2	0	0	0	0	0	0	39.07
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	34.17	0	0	34.17	0	0
6	0	34.17	0	34.17	34.17	0	0
7	0	34.17	0	34.17	34.17	0	0
8	0	34.17	34.17	34.17	34.17	64.27	0
9	0	34.17	34.17	34.17	34.17	64.27	0
10	0	34.17	34.17	34.17	0	29.75	0
11	0	34.17	34.17	34.17	0	0	0
12	0	0	34.17	34.17	0	0	0
13	0	0	34.17	34.17	0	0	0
14	0	0	34.17	0	0	27.27	0
15	0	0	34.17	0	34.17	61.32	0
16	0	0	34.17	0	34.17	33.03	0
17	0	0	34.17	0	34.17	33.03	0
18	0	34.17	34.17	0	0	0	0
19	0	34.17	34.17	0	34.17	0	0
20	0	34.17	0	0	31.27	0	0
21	0	34.17	0	0	31.27	0	0
22	0	0	0	0	31.27	0	0
23	0	0	0	0	31.27	0	0
24	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	0	0	0	38.25	0
29	0	0	0	0	0	17.06	0
30	0	0	0	0	0	40.16	0
31		0			0		0
TOTAL	0.00	375.82	409.98	273.32	432.58	408.41	78.96

GRAND TOTAL 1979.08

* April-August estimates based on observed and estimated dates of diversions and flowmeter readings after installion (9-4-92).

Appendix B

ESTIMATED DENSITY OF EGGS AND LARVAE, BY DIVERSION SITE

Delta Agricultural Diversion Evaluation
1992 Pilot Study

Appendix B. ESTIMATED EGG AND LARVAL DENSITIES BY DIVERSION SITE COLLECTED UNDER THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 1 - TWITCHELL ISLAND
(Sevenmile Slough Diversion)

DENSITIES
(Number per Cubic Meter)

DATE	MISC EGGS	LARVAE: ASHAD	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRARC	YF GOBY	ISS	LONGFIN MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS
24-Jun-92	0	0	0.1911	0	0	0	0.9557	0	0	0	0	0	0	0	0	0	0
25-Jun-92	0	0	0.4149	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09-Jul-92	0	0	0.1035	0	0	0	0.0518	0	0	0	0	0	0	0	0	0	0
20-Jul-92	0	0	0.4176	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Sep-92	0	0	0	0	0	0	0.1775	0	0.04	0	0	0	0	0	0	0	0
22-Sep-92	0	0	0	0	0	0	0	0	5.66	0	0	0	0	0	0	0	0
TOTALS	0	0	1.1272	0	0	0	1.185	0	5.7	0	0	0	0	0	0	0	0

Appendix B. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY DIVERSION SITE COLLECTED UNDER THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 2 - BACON ISLAND

DENSITIES
(Number per Cubic Meter)

DATE	MISC EGGS	LARVAE: ASHAD	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRARC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS
20-Apr-92 *	0	0	0	0	0.0211	0	0.0211	0	0	0	0	0.0211	0	0	0	0	0.0843
22-Apr-92	0	0	0	0	0.0211	0	0.0211	0	0	0	0	0.0211	0	0	0	0	0.0843
27-Apr-92	0	0	0	0	0.0519	0	0	0	0	0	0	0.0104	0	0	0	0.0104	0.0311
28-Apr-92	0	0	0	0	0.0595	0.0297	0	0	0	0	0	0.0297	0	0	0	0	0
30-Apr-92	0	0	0	0	0	0	0	0	0	0	0	0.0208	0	0	0	0	0
04-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3236
12-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-May-92	0	0	0.1077	0	0	0.1077	0	0	0	0	0	0.1077	0	0	0	0.1077	0.1077
18-May-92	0	0	0.0562	0	0	0	0	0	0	0	0	0.0562	0	0	0	0.1124	0.4497
22-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0569	0.0569
26-May-92	0	0	0.7795	0	0	0	0	0	0	0	0	0	0	0	0	0.3298	0
27-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0436	0.0872
28-May-92	0	0	0.0582	0	0	0	0	0	0	0	0	0	0	0	0	0.0874	0
01-Jun-92	0	0	0.0262	0	0	0	0	0	0	0	0	0	0	0	0	0.4194	0.0262
03-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4604	0.0576
05-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1625	0
09-Jun-92	0	0	0.0383	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0383
11-Jun-92	0	0	0.1423	0	0	0	0	0	0	0	0	0	0	0	0	0.1627	0
12-Jun-92	0	0	0.1584	0	0	0	0	0	0	0	0	0	0	0	0	0.2262	0
15-Jun-92	0	0	0.0367	0	0	0	0	0	0	0	0	0	0	0	0	0.3482	0
17-Jun-92	0	0	0.0314	0	0	0	0	0	0	0	0	0	0	0	0	1.2565	0
19-Jun-92	0	0	0.0301	0	0	0	0	0	0	0	0	0	0	0	0	0.3914	0
22-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2413	0
23-Jun-92	0	0	1.1963	0	0	0	0	0	0	0	0	0	0	0	0	0.2991	0
24-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jun-92	0	0	0.7445	0	0	0	0	0	0	0	0	0	0	0	0	0.0827	0
29-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1417	0
01-Jul-92	0	0	0.1889	0	0	0	0	0	0	0	0	0	0	0	0	0.5666	0
03-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.5623	0
06-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.3203	0
07-Jul-92	0	0	0.692	0	0	0	0	0	0	0	0	0	0	0	0	2.076	0
09-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1084	0
17-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jul-92	0	0	2.0388	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jul-92	0	0.0443	0.0776	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jul-92	0	0	0	0	0	0	0.406	0	0	0	0	0	0	0	0	0	0
23-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jul-92	0	0	0	0	0	0	1.7888	0	0	0	0	0	0	0	0	1.7888	0
30-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.0866	0
05-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Aug-92	0	0	4.8618	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Aug-92	0	0	0.0084	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Aug-92	0	0	0.0467	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Aug-92	0	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0.0172	0
27-Aug-92	0	0	0.0132	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-Sep-92	0	0	0.8986	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2279	0
16-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2583	0
17-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0.0443	12.262	0	0.1535	0.1375	2.2369	0	0	0	0	0.267	0	0	0	19.953	1.3469

* No sample taken, densities estimated in order to calculate entrainment.

Appendix B. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY DIVERSION SITE COLLECTED UNDER THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 2 -BACON ISLAND

STRIPED BASS DENSITIES
(Number per Cubic Meter)

DATE	SITE#	EGGS	LARVAE: SIZE GROUP 3-6 mm	7-10 mm	11-14 mm	15-18 mm	19-20 mm	3-20 mm
20-Apr-92 *	2	0	0	0.0843	0	0	0	0.0843
22-Apr-92	2	0	0	0.0843	0	0	0	0.0843
27-Apr-92	2	0	0	0.0311	0	0	0	0.0311
28-Apr-92	2	0	0	0	0	0	0	0
30-Apr-92	2	0	0	0	0	0	0	0
04-May-92	2	0	0	0	0	0	0	0
06-May-92	2	0	0	0	0	0	0	0
07-May-92	2	0	0	0	0	0	0	0
08-May-92	2	0	0	0	0	0	0	0
11-May-92	2	0	0.3236	0	0	0	0	0.3236
12-May-92	2	0	0	0	0	0	0	0
13-May-92	2	0	0	0.1077	0	0	0	0.1077
18-May-92	2	0	0.0562	0.3935	0	0	0	0.4497
22-May-92	2	0	0	0.0569	0	0	0	0.0569
26-May-92	2	0	0	0	0	0	0	0
27-May-92	2	0	0	0.0872	0	0	0	0.0872
28-May-92	2	0	0	0	0	0	0	0
01-Jun-92	2	0	0.0262	0	0	0	0	0.0262
03-Jun-92	2	0	0	0	0	0.0288	0.0288	0.0576
05-Jun-92	2	0	0	0	0	0	0	0
09-Jun-92	2	0	0	0.0383	0	0	0	0.0383
11-Jun-92	2	0	0	0	0	0	0	0
12-Jun-92	2	0	0	0	0	0	0	0
15-Jun-92	2	0	0	0	0	0	0	0
17-Jun-92	2	0	0	0	0	0	0	0
19-Jun-92	2	0	0	0	0	0	0	0
22-Jun-92	2	0	0	0	0	0	0	0
23-Jun-92	2	0	0	0	0	0	0	0
24-Jun-92	2	0	0	0	0	0	0	0
25-Jun-92	2	0	0	0	0	0	0	0
29-Jun-92	2	0	0	0	0	0	0	0
01-Jul-92	2	0	0	0	0	0	0	0
03-Jul-92	2	0	0	0	0	0	0	0
06-Jul-92	2	0	0	0	0	0	0	0
07-Jul-92	2	0	0	0	0	0	0	0
09-Jul-92	2	0	0	0	0	0	0	0
10-Jul-92	2	0	0	0	0	0	0	0
13-Jul-92	2	0	0	0	0	0	0	0
15-Jul-92	2	0	0	0	0	0	0	0
17-Jul-92	2	0	0	0	0	0	0	0
20-Jul-92	2	0	0	0	0	0	0	0
21-Jul-92	2	0	0	0	0	0	0	0
22-Jul-92	2	0	0	0	0	0	0	0
23-Jul-92	2	0	0	0	0	0	0	0
28-Jul-92	2	0	0	0	0	0	0	0
30-Jul-92	2	0	0	0	0	0	0	0
05-Aug-92	2	0	0	0	0	0	0	0
06-Aug-92	2	0	0	0	0	0	0	0
11-Aug-92	2	0	0	0	0	0	0	0
13-Aug-92	2	0	0	0	0	0	0	0
18-Aug-92	2	0	0	0	0	0	0	0
19-Aug-92	2	0	0	0	0	0	0	0
20-Aug-92	2	0	0	0	0	0	0	0
24-Aug-92	2	0	0	0	0	0	0	0
25-Aug-92	2	0	0	0	0	0	0	0
26-Aug-92	2	0	0	0	0	0	0	0
27-Aug-92	2	0	0	0	0	0	0	0
01-Sep-92	2	0	0	0	0	0	0	0
02-Sep-92	2	0	0	0	0	0	0	0
03-Sep-92	2	0	0	0	0	0	0	0
08-Sep-92	2	0	0	0	0	0	0	0
14-Sep-92	2	0	0	0	0	0	0	0
15-Sep-92	2	0	0	0	0	0	0	0
16-Sep-92	2	0	0	0	0	0	0	0
17-Sep-92	2	0	0	0	0	0	0	0
21-Sep-92	2	0	0	0	0	0	0	0
22-Sep-92	2	0	0	0	0	0	0	0
23-Sep-92	2	0	0	0	0	0	0	0
24-Sep-92	2	0	0	0	0	0	0	0
TOTALS		0	0.406	0.8834	0	0.0288	0.0288	1.3469

* No sample taken, densities estimated in order to calculate entrainment.

Appendix B. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY DIVERSION SITE COLLECTED UNDER THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 3 - MCDONALD ISLAND (Unscreened)

DENSITIES
(Number per Cubic Meter)

	LARVAE:																
DATE	MISC EGGS	ASHAD	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRARC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS
14-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-May-92	0	0	0.8743	0	0	0	0	0	0	0	0	0	0	0	0	3.5518	0
22-May-92	0.0595	0	0.1191	0	0	0	0	0	0	0	0	0	0	0	0	0.1786	0
26-May-92	0	0	5.8928	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0642	0
28-May-92	0	0	1.7602	0	0	0	0	0	0	0	0	0	0	0	0	0.176	0
01-Jun-92	0	0	4.2154	0	0	0	0.0327	0	0	0	0	0	0	0	0	0	0
03-Jun-92	0	0	0.8146	0	0	0	0	0	0	0	0	0	0	0	0	0.0354	0
05-Jun-92	0	0	6.6872	0	0	0	0	0	0	0	0	0	0	0	0	4.2882	0
09-Jun-92	0	0	1.6722	0	0	0	0	0	0	0	0	0	0	0	0	0.1174	0
11-Jun-92	0	0	1.8992	0	0	0	0	0	0	0.02	0	0	0	0	0	0.9744	0
12-Jun-92	0.0156	0	3.1591	0	0	0	0.0156	0	0	0	0	0	0	0	0	0.172	0
15-Jun-92	0.0158	0	0.2836	0	0	0	0.0158	0	0	0.03	0	0	0	0	0	12.59	0
17-Jun-92	0	0	0.6366	0	0	0	0	0	0	0	0	0	0	0	0	0.0653	0
19-Jun-92	0	0	0.1539	0	0	0	0	0	0	0	0	0	0	0	0	0.0616	0
22-Jun-92	0	0	1.0179	0	0	0	0	0	0	0	0	0	0	0	0	1.129	0
23-Jun-92	0.0212	0	1.8685	0	0	0	0	0	0	0	0	0	0	0	0	0.1062	0
24-Jun-92	0	0	0.4617	0	0	0	0	0	0	0	0	0	0	0	0	0.1204	0
25-Jun-92	0	0	3.0661	0	0	0	0.0634	0	0	0	0	0	0	0	0	0.1692	0
29-Jun-92	0	0	0.3205	0	0	0	0	0	0	0	0	0	0	0	0	0.0247	0
30-Jun-92 *	0	0	0.3205	0	0	0	0	0	0	0	0	0	0	0	0	0.0247	0
01-Jul-92	0	0	0.4992	0	0	0	0	0	0	0	0	0	0	0	0	0.0713	0
03-Jul-92	0	0	2.3236	0	0	0	0	0	0	0	0	0	0	0	0	0.9295	0
06-Jul-92	0	0	0.5643	0	0	0	0	0	0	0	0	0	0	0	0	1.1286	0
07-Jul-92	0	0	0.0299	0	0	0	0	0	0	0	0	0	0	0	0	0.0597	0
08-Jul-92	0	0	0.0302	0	0	0	0.0302	0	0	0	0	0	0	0	0	0	0
09-Jul-92	0	0	2.6457	0	0	0	0	0	0	0	0	0	0	0	0	0.441	0
05-Aug-92	0	0	0.0892	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Aug-92	0	0	0.1649	0	0	0	).0097	0	0	0	0	0	0	0	0	0	0
TOTALS	0.1122	0	41.57	0	0	0	0.1674	0	0	0.05	0	0	0	0	0	26.479	0

* Densities estimated in order to estimate entrainment.

Appendix B. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY DIVERSION SITE COLLECTED UNDER THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 3 - MCDONALD ISLAND (Screened)

DENSITIES
(Number per Cubic Meter)

DATE	EGGS: MISC	LARVAE: ASHAD	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRARC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS
06-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-May-92	0.0633	0	0.0633	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-May-92	0	0	0.6122	0	0	0	0	0	0	0	0	0	0	0	0	0.0557	0
28-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Jun-92	0	0	0.1643	0	0	0	0	0	0	0	0	0	0	0	0	5.791	0
09-Jun-92	0	0	0.0154	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Jun-92	0.0573	0	0.0191	0	0	0	0	0	0	0	0	0	0	0	0	0.1146	0
12-Jun-92	0	0	0.0182	0	0	0	0	0	0	0	0	0	0	0	0	0.0727	0
15-Jun-92	0.0157	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jun-92	0	0	0.0383	0	0	0	0	0	0	0	0	0	0	0	0	0.0766	0
19-Jun-92	0	0	0.0775	0	0	0	0	0	0	0	0	0	0	0	0	0.1551	0
22-Jun-92	0	0	0.042	0	0	0	0	0	0	0	0	0	0	0	0	0.6719	0
23-Jun-92	0.1181	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0169	0
24-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.041	0
29-Jun-92	0	0	0.025	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jun-92 *	0	0	0.025	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0313	0
06-Jul-92	0	0	0.0363	0	0	0	0	0	0	0	0	0	0	0	0	1.2718	0
07-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3075	0
08-Jul-92	0.0505	0	0.1263	0	0	0	0	0	0	0	0	0	0	0	0	0.0505	0
08-Jul-92	0.0505 *	0	0.1263	0	0	0	0	0	0	0	0	0	0	0	0	0.0505	0
09-Jul-92 *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Aug-92 *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Aug-92 *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Aug-92	0	0	0.0112	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0.3555	0	1.4004	0	0	0	0	0	0	0	0	0	0	0	0	8.7069	0

* Densities estimated in order to estimate entrainment.

Appendix B. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY DIVERSION SITE COLLECTED UNDER THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 4 - NAGLEE BURK

DENSITIES
(Number per Cubic Meter)

DATE	MISC EGGS	LARVAE: ASHAD	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRARC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS
05-May-92 *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07-May-92	0	0	1.6125	0	0	0	0	0	0	0	0	0.0949	0	0	0	0.4743	0
08-May-92	0	0	0.2418	0	0	0	0	0	0	0	0	0	0	0	0	0.0726	0
11-May-92	0	0	0.9816	0	0	0	0.0633	0	0	0	0	0	0	0	0	0.285	0
18-May-92	0	0	2.0218	0	0	0	0	0	0	0	0	0	0	0	0	0.2186	0
08-Jun-92 *	0	0	0.5261	0	0	0	0.3507	0	0	0	0	0	0	0	0	0.0438	0
09-Jun-92	0	0	0.5261	0	0	0	0.3507	0	0	0	0	0	0	0	0	0.0438	0
10-Jun-92 *	0	0	0.3401	0	0	0	0.0267	0	0	0	0	0	0	0	0	0.2134	0
11-Jun-92	0	0	1.3122	0	0	0.2187	0	0	0	0	0	0	0	0	0	0.4374	0
12-Jun-92	0	0	0.2403	0	0	0	0	0	0	0	0	0	0	0	0	1.1213	0
15-Jun-92	0	0	1.843	0	0	0	0.0888	0	0	0	0	0	0	0	0	0.0666	0
17-Jun-92	0	0	0.0235	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0944	0
06-Jul-92 *	0	0	0.0485	0	0	0	0	0	0	0	0	0	0	0	0	0.1938	0
07-Jul-92	0	0	0.0485	0	0	0	0	0	0	0	0	0	0	0	0	0.1938	0
09-Jul-92	0.0235	0	0.1173	0	0	0	0	0	0	0	0	0	0	0	0	0.0704	0
10-Jul-92	0.5763	0	0	0	0	0	0	0	0	0	0	0	0	0	0.576	0	0
13-Jul-92	0	0	0.0488	0	0	0	0	0	0	0	0	0	0	0	0	0.0488	0
05-Aug-92	0	0	0	0	0	0	0.0234	0	0	0	0	0	0	0	0	0.1872	0
06-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3047	0
15-Aug-92 *	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Aug-92	0	0	0.1879	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0.5998	0	10.12	0	0	0.2187	0.9037	0	0	0	0	0.0949	0	0	0.576	4.0699	0

* No sample taken, densities estimated in order to calculate entrainment.

Appendix C

ESTIMATED DENSITY OF EGGS AND LARVAE, BY CHANNEL SITE

Delta Agricultural Diversion Evaluation
1992 Pilot Study

Appendix C. ESTIMATED EGG AND LARVAL DENSITIES BY CHANNEL SITE COLLECTED FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, FEBRUARY-SEPTEMBER 1992.

STATION 934 - SAN JOAQUIN RIVER (Twitchell Island)

DENSITIES
(Number per Cubic Meter)

	EGGS:	LARVAE:														
DATE	MISC.	STRIPED BASS	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRAC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS
14-Apr-92	0	0.029	0	0.0058	0.2434	0	0	0	0	0	0	0.0116	0	0	0	0.0116	1.2864
16-Apr-92	0	2.246	0	0.0516	1.0843	0	0	0.0516	0	0	0	0.0774	0	0.0258	0	0.0774	3.0205
20-Apr-92	0	0.3708	0	0.0501	0.6715	0	0	0	0	0	0	0	0	0	0	0.0301	1.0223
22-Apr-92	0	0.1513	0	0.0189	0.0284	0	0	0	0	0	0	0.0095	0	0	0	0	0.4065
24-Apr-92	0	0	0	0.0096	0.0431	0	0	0.0048	0	0	0	0	0	0	0	0.0383	0.3688
26-Apr-92	0	0.0224	0	0	0.4481	0	0	0	0	0	0	0.0149	0	0	0	0.0597	0.926
28-Apr-92	0	0.7773	0.0065	0.0065	0.1568	0.0327	0	0	0	0	0	0.0196	0	0	0	0.0718	0.8426
30-Apr-92	0	3.8928	0	0.0311	0.7786	0.0156	0	0	0	0	0	0.0623	0	0	0	0.1557	2.5693
02-May-92	0	0.2038	0.0093	0	0.2594	0.0278	0	0	0	0	0	0.0185	0	0	0	0.0463	2.5661
04-May-92	0	1.705	0.0355	0	2.4154	0.1776	0	0	0	0	0	0	0	0	0	3.2323	16.694
06-May-92	0	1.7246	0	0	0.3338	0.0278	0	0	0	0	0	0	0	0	0	0.1947	5.0625
08-May-92	0	0.0914	0	0.0229	0.0686	0.0229	0	0	0	0	0	0	0	0	0	0.0229	1.2343
10-May-92	0	0.1932	0	0	0	0.0644	0	0	0	0	0	0	0	0	0	0	5.0233
12-May-92	0	0.7897	0	0	0.0292	0	0	0	0	0	0	0	0	0	0	0	11.874
14-May-92	0	0.4765	0	0.0953	0.0953	0.0953	0	0	0	0	0	0	0	0	0	0.1906	10.483
16-May-92	0	0.0385	0	0.0385	0.0769	0.1154	0.0385	0	0	0	0	0	0	0	0	0.0769	4.1156
20-May-92	0	0	0	0	0.0829	0	0	0.0829	0	0	0	0	0	0	0	0.0829	0.8295
22-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.6092
26-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3669
28-May-92	0	0	0.0275	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4131
30-May-92	0	0	0.047	0	0	0	0	0	0	0	0	0	0	0	0	3.6866	1.6672
01-Jun-92	0	0	0	0	0	0.0368	0	0	0	0	0	0	0	0	0	2.9052	2.8684
03-Jun-92	0	0	0.0495	0	0	0	0	0	0	0	0	0	0	0	0	5.3977	0.7428
07-Jun-92	0	0	0.6387	0.0073	0	0	0	0	0	0	0	0	0	0	0	6.6582	0.0073
09-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0175	0.0087
11-Jun-92	0	0	0	0	0	0.0167	0.0167	0	0	0	0	0	0	0	0	0.533	0.0666
12-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.7443	0.1804
15-Jun-92	0	0	1.0511	0	0	0.0258	0	0	0	0	0	0	0	0	0	2.4826	0.0064
17-Jun-92	0	0	3.5313	0	0	0.0215	0	0	0	0	0	0	0	0	0	16.143	0.0215
26-Jun-92	0	0	0.0798	0	0	0	0.016	0	0	0	0	0	0	0	0	0.2074	0
29-Jun-92	0	0	0.2583	0	0	0	0.022	0	0	0	0	0	0	0	0	1.8742	0
01-Jul-92	0	0	0.3435	0	0	0	0.0127	0	0	0	0	0	0	0	0	3.5322	0
13-Jul-92	0	0	0.0053	0	0	0	0	0	0	0	0	0	0	0	0	1.4764	0
14-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.2708	0
15-Jul-92	0	0	0.0059	0	0	0	0	0	0	0	0	0	0	0	0	1.2586	0
20-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1653	0
28-Jul-92	0	0	0.0074	0	0	0	0	0	0	0	0	0	0	0	0	1.2258	0
18-Aug-92	0	0	0.0144	0	0	0	0	0	0	0	0	0	0	0	0	0.1945	0
26-Aug-92	0	0	0.0211	0	0	0	0	0	0	0	0	0	0	0	0	0.0506	0
27-Aug-92	0	0	0.0254	0	0	0	0	0	0	0	0	0	0	0	0	0.1186	0
31-Aug-92	0	0	0.0115	0	0	0	0	0	0	0	0	0	0	0	0	0.0154	0
16-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	12.712	6.1691	0.3377	6.8156	0.6801	0.1058	0.1394	0	0	0	0.2138	0	0.0258	0	55.249	77.284

Appendix C. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY CHANNEL SITE COLLECTED FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, FEBRUARY-SEPTEMBER 1992.

STATION 934 - SAN JOAQUIN RIVER (Twitchell Island)

STRIPED BASS DENSITIES (Number per Cubic Meter)

DATE	STA#	EGGS	LARVAE: 3-6 mm	SIZE GROUP 7-10 mm	11-14 mm	15-18 mm	19-20 mm	3-20 mm
14-Apr-92	934	0.029	1.0894	0.197	0	0	0	1.2864
16-Apr-92	934	2.246	2.246	0.7745	0	0	0	3.0205
20-Apr-92	934	0.3708	0.7918	0.2305	0	0	0	1.0223
22-Apr-92	934	0.1513	0.2552	0.1513	0	0	0	0.4065
24-Apr-92	934	0	0.3545	0.0144	0	0	0	0.3688
26-Apr-92	934	0.0224	0.8364	0.0896	0	0	0	0.926
28-Apr-92	934	0.7773	0.6793	0.1633	0	0	0	0.8426
30-Apr-92	934	3.8928	1.8218	0.7474	0	0	0	2.5693
02-May-92	934	0.2038	2.0936	0.4725	0	0	0	2.5661
04-May-92	934	1.705	15.984	0.7104	0	0	0	16.694
06-May-92	934	1.7246	4.089	0.9736	0	0	0	5.0625
08-May-92	934	0.0914	1.2115	0.0229	0	0	0	1.2343
10-May-92	934	0.1932	4.4437	0.5152	0.0644	0	0	5.0233
12-May-92	934	0.7897	10.178	1.5793	0.117	0	0	11.874
14-May-92	934	0.4765	8.0052	2.3825	0.0953	0	0	10.483
16-May-92	934	0.0385	3.0771	0.9616	0.0769	0	0	4.1156
20-May-92	934	0	0.4147	0.3318	0.0829	0	0	0.8295
22-May-92	934	0	1.5504	0.7941	0.1891	0.0378	0.0378	2.6092
26-May-92	934	0	0.3057	0.0611	0	0	0	0.3669
28-May-92	934	0	0.0826	0.1102	0.1928	0.0275	0	0.4131
30-May-92	934	0	1.6202	0.047	0	0	0	1.6672
01-Jun-92	934	0	2.0593	0.3677	0.2942	0.1103	0.0368	2.8684
03-Jun-92	934	0	0.7428	0	0	0	0	0.7428
07-Jun-92	934	0	0	0.0073	0	0	0	0.0073
09-Jun-92	934	0	0	0	0.0087	0	0	0.0087
11-Jun-92	934	0	0	0.0666	0	0	0	0.0666
12-Jun-92	934	0	0	0.1466	0.0226	0.0113	0	0.1804
15-Jun-92	934	0	0	0.0064	0	0	0	0.0064
17-Jun-92	934	0	0	0	0.0215	0	0	0.0215
26-Jun-92	934	0	0	0	0	0	0	0
29-Jun-92	934	0	0	0	0	0	0	0
01-Jul-92	934	0	0	0	0	0	0	0
13-Jul-92	934	0	0	0	0	0	0	0
14-Jul-92	934	0	0	0	0	0	0	0
15-Jul-92	934	0	0	0	0	0	0	0
20-Jul-92	934	0	0	0	0	0	0	0
28-Jul-92	934	0	0	0	0	0	0	0
18-Aug-92	934	0	0	0	0	0	0	0
26-Aug-92	934	0	0	0	0	0	0	0
27-Aug-92	934	0	0	0	0	0	0	0
31-Aug-92	934	0	0	0	0	0	0	0
16-Sep-92	934	0	0	0	0	0	0	0
17-Sep-92	934	0	0	0	0	0	0	0
23-Sep-92	934	0	0	0	0	0	0	0
TOTALS		12.712	63.932	11.925	1.1653	0.187	0.0746	77.284

Appendix C. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY CHANNEL SITE COLLECTED FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, FEBRUARY-SEPTEMBER 1992.

STATION 932 - MIDDLE RIVER (Bacon Island Diversion) DENSITIES (Number per Cubic Meter)

	EGGS:	LARVAE:														
DATE	MISC.	STRIPED BASS	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRAC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS
06-Apr-92	0	0	0	0	0.8295	0	0.0488	0	0	0	0	0.0081	0	0	0	0	0.0895
08-Apr-92	0	0	0	0	0.4103	0	0.0057	0	0	0	0	0.0285	0	0	0	0	0.0684
10-Apr-92	0	0	0	0	0.1647	0	0	0	0	0	0	0.0084	0	0	0	0	0.1309
12-Apr-92	0	0	0	0	1.4261	0	0.004	0	0	0	0	0.0159	0	0	0	0	0.0996
14-Apr-92	0	0	0	0.0048	0.1	0	0	0	0	0	0	0.0143	0	0	0	0.0048	0.0429
16-Apr-92	0	0	0	0	0.0619	0	0.0044	0	0	0	0	0	0	0	0	0	0.0177
20-Apr-92	0	0	0.0085	0	0.3069	0	0.0171	0	0	0	0	0.0256	0	0	0	0	0.0682
22-Apr-92	0	0	0	0	0.3502	0	0	0	0	0	0	0.05	0	0	0.05	0	0.4503
24-Apr-92	0	0	0	0.0194	0.2903	0	0	0	0	0	0	0.0968	0	0	0	0	0.1161
26-Apr-92	0	0	0	0.0093	0.2146	0.0187	0	0	0	0	0	0	0	0	0	0.0187	0.1026
28-Apr-92	0	0	0	0	0.122	0	0	0	0	0	0	0	0	0	0	0.1084	0.1355
30-Apr-92	0	0	0	0	0.0537	0	0	0	0	0	0	0	0	0	0	0.0493	0.0314
02-May-92	0	0	0	0	0.0788	0.0061	0	0	0	0	0	0.0121	0	0	0	0.0061	0.0788
04-May-92	0	0	0	0.0652	0.2445	0.0163	0	0	0	0	0	0	0	0	0	0.1141	0.538
06-May-92	0	0	0	0	0.0227	0	0	0	0	0	0	0	0	0	0	0	0.1812
08-May-92	0	0	0	0	0	0	0	0	0	0	0	0.0276	0	0	0	0	0.3039
10-May-92	0	0	0	0	0.0345	0.0345	0	0	0	0	0	0	0	0	0	0.0689	0.3101
12-May-92	0	0	0.0325	0	0.0325	0	0	0	0	0	0	0.0325	0	0	0	0.0651	0.2278
14-May-92	0	0	0.0239	0	0.0239	0	0	0	0	0	0	0.0239	0	0	0	0.0477	0.5487
16-May-92	0	0	0	0	0	0	0.0182	0	0	0	0	0	0	0	0	0.0547	0.1641
20-May-92	0	0	0.0216	0	0.0216	0	0	0	0	0	0	0	0	0	0	0.0649	0.1731
22-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2607	0.1862
26-May-92	0	0	0.1255	0	0	0	0	0	0	0	0	0	0	0	0	2.1692	0.0896
28-May-92	0	0	0.0906	0	0	0.0226	0	0	0	0	0	0	0	0	0	1.6193	0.0906
30-May-92	0	0	0.6209	0	0	0	0	0	0	0	0	0	0	0	0	2.5524	0.0296
01-Jun-92	0	0	1.0223	0	0	0	0.0122	0	0	0	0	0	0	0	0	7.2045	0.0852
03-Jun-92	0	0	0.0738	0	0	0	0	0	0	0	0	0	0	0	0	1.0654	0.0184
05-Jun-92	0	0	0.0372	0	0	0	0	0	0	0	0	0	0	0	0	0.6445	0.0744
07-Jun-92	0	0	0.2778	0	0	0	0.0044	0	0	0	0	0	0	0	0	2.4874	0.0088
09-Jun-92	0	0	0.1506	0	0	0	0	0	0	0	0	0	0	0	0	3.1628	0.0086
11-Jun-92	0	0	0.1593	0	0	0	0	0	0	0	0	0	0	0	0	2.04	0
12-Jun-92	0	0	0.1002	0	0	0	0.0046	0	0	0	0	0	0	0	0	1.4618	0
15-Jun-92	0	0	0.1475	0	0	0	0	0	0	0	0	0	0	0	0	3.7246	0
17-Jun-92	0	0	0.2368	0	0	0	0.0055	0	0	0	0	0	0	0	0	2.6153	0
19-Jun-92	0	0	0.1954	0	0	0	0	0	0	0	0	0	0	0	0	1.586	0
22-Jun-92	0	0	0.5785	0	0	0	0	0	0	0	0	0	0	0	0	1.3196	0
23-Jun-92	0	0	0.3332	0	0	0	0	0	0	0	0	0	0	0	0	4.6089	0
25-Jun-92	0	0	0.0138	0	0	0	0	0	0	0	0	0	0	0	0	0.6474	0
26-Jun-92	0	0	0.0839	0	0	0	0.0034	0	0	0	0	0	0	0	0	0.4296	0
29-Jun-92	0	0	0.8958	0	0	0	0	0	0	0	0	0	0	0	0	7.2113	0
01-Jul-92	0	0	0.2152	0	0	0	0	0	0	0	0	0	0	0	0	0.9538	0
13-Jul-92	0	0	0.0085	0	0	0	0	0	0	0	0	0	0	0	0	0.0127	0
14-Jul-92	0	0	0.0204	0	0	0	0	0	0	0	0	0	0	0	0	0.4973	0
15-Jul-92	0	0	0.0262	0	0	0	0	0	0	0	0	0	0	0	0	0.3667	0
20-Jul-92	0	0	0.0704	0	0	0	0	0	0	0	0	0	0	0	0	0.4714	0
28-Jul-92	0	0	0.0609	0	0	0	0.0051	0	0	0	0	0	0	0	0	0.4671	0
18-Aug-92	0	0	0.0755	0	0	0	0	0	0	0	0	0	0	0	0	0.0874	0
26-Aug-92	0	0	0.16	0	0	0	0	0	0	0	0	0	0	0	0	0.013	0
27-Aug-92	0	0	0.0544	0	0	0	0	0	0	0	0	0	0	0	0	0.0145	0
31-Aug-92	0	0	0.0307	0	0	0	0	0	0	0	0	0	0	0	0	0.0038	0
16-Sep-92	0	0	0.004	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	5.9556	0.0987	4.7887	0.0981	0.1333	0	0	0	0	0.3438	0	0	0.05	50.301	4.4703

Appendix C. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY CHANNEL SITE COLLECTED FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, FEBRUARY-SEPTEMBER 1992.

STATION 932 - MIDDLE RIVER (Bacon Island)

STRIPED BASS DENSITIES (Number per Cubic Meter)

DATE	STA#	EGGS	LARVAE: SIZE GROUP 3-6 mm	7-10 mm	11-14 mm	15-18 mm	19-20 mm	3-20 mm
06-Apr-92	932	0	0.0813	0.0081	0	0	0	0.0895
08-Apr-92	932	0	0.0627	0.0057	0	0	0	0.0684
10-Apr-92	932	0	0.1183	0.0127	0	0	0	0.1309
12-Apr-92	932	0	0.0837	0.0159	0	0	0	0.0996
14-Apr-92	932	0	0.0286	0.0143	0	0	0	0.0429
16-Apr-92	932	0	0.0044	0.0133	0	0	0	0.0177
20-Apr-92	932	0	0.0512	0.0171	0	0	0	0.0682
22-Apr-92	932	0	0.3002	0.1501	0	0	0	0.4503
24-Apr-92	932	0	0.0968	0.0194	0	0	0	0.1161
26-Apr-92	932	0	0.0746	0.028	0	0	0	0.1026
28-Apr-92	932	0	0.1084	0.0271	0	0	0	0.1355
30-Apr-92	932	0	0.0224	0.009	0	0	0	0.0314
02-May-92	932	0	0.0545	0.0242	0	0	0	0.0788
04-May-92	932	0	0.4728	0.0652	0	0	0	0.538
06-May-92	932	0	0.1586	0.0227	0	0	0	0.1812
08-May-92	932	0	0.2211	0.0829	0	0	0	0.3039
10-May-92	932	0	0.0345	0.2756	0	0	0	0.3101
12-May-92	932	0	0.0651	0.1627	0	0	0	0.2278
14-May-92	932	0	0.334	0.1909	0.0239	0	0	0.5487
16-May-92	932	0	0.1641	0	0	0	0	0.1641
20-May-92	932	0	0.1299	0.0433	0	0	0	0.1731
22-May-92	932	0	0	0.1862	0	0	0	0.1862
26-May-92	932	0	0.0538	0.0359	0	0	0	0.0896
28-May-92	932	0	0.0679	0.0113	0.0113	0	0	0.0906
30-May-92	932	0	0	0.0197	0.0099	0	0	0.0296
01-Jun-92	932	0	0.0122	0.0365	0.0243	0.0122	0	0.0852
03-Jun-92	932	0	0.0046	0.0138	0	0	0	0.0184
05-Jun-92	932	0	0.0124	0.0434	0.0186	0	0	0.0744
07-Jun-92	932	0	0	0.0088	0	0	0	0.0088
09-Jun-92	932	0	0	0	0.0086	0	0	0.0086
11-Jun-92	932	0	0	0	0	0	0	0
12-Jun-92	932	0	0	0	0	0	0	0
15-Jun-92	932	0	0	0	0	0	0	0
17-Jun-92	932	0	0	0	0	0	0	0
19-Jun-92	932	0	0	0	0	0	0	0
22-Jun-92	932	0	0	0	0	0	0	0
23-Jun-92	932	0	0	0	0	0	0	0
25-Jun-92	932	0	0	0	0	0	0	0
26-Jun-92	932	0	0	0	0	0	0	0
29-Jun-92	932	0	0	0	0	0	0	0
01-Jul-92	932	0	0	0	0	0	0	0
13-Jul-92	932	0	0	0	0	0	0	0
14-Jul-92	932	0	0	0	0	0	0	0
15-Jul-92	932	0	0	0	0	0	0	0
20-Jul-92	932	0	0	0	0	0	0	0
28-Jul-92	932	0	0	0	0	0	0	0
18-Aug-92	932	0	0	0	0	0	0	0
26-Aug-92	932	0	0	0	0	0	0	0
27-Aug-92	932	0	0	0	0	0	0	0
31-Aug-92	932	0	0	0	0	0	0	0
16-Sep-92	932	0	0	0	0	0	0	0
17-Sep-92	932	0	0	0	0	0	0	0
23-Sep-92	932	0	0	0	0	0	0	0
TOTALS		0	2.8178	1.5437	0.0966	0.0122	0	4.4703

Appendix C. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY CHANNEL SITE COLLECTED FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, FEBRUARY-SEPTEMBER 1992.

STATION 933 - TURNER CUT (McDonald Island Diversion) DENSITIES (Number per Cubic Meter)

	EGGS:	LARVAE:														
DATE	MISC.	STRIPED BASS	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRAC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS
06-Apr-92	0	0	0	0.0073	0.374	0	0	0	0	0	0	0.0147	0	0	0	0.0073	0
08-Apr-92	0	0	0	0.0407	0.8541	0	0	0	0	0	0	0.061	0	0	0	0.1017	0.0407
10-Apr-92	0	0	0	0	0.5113	0.0098	0	0	0	0	0	0.0393	0	0	0	0.7276	0.059
12-Apr-92	0	0	0	0	0.1469	0.0043	0	0	0	0	0	0.0475	0	0	0	0.2074	0.0216
14-Apr-92	0	0	0	0	0.1157	0	0	0	0	0	0	0.0281	0	0	0	0.0245	0.007
16-Apr-92	0	0	0.0115	0	0.2219	0.0038	0	0	0	0	0	0.023	0	0	0	0.3787	0.0077
20-Apr-92	0	0	0.0217	0	0.6592	0	0	0	0	0	0	0.0797	0	0	0	0.6737	0.0435
22-Apr-92	0	0	0.0212	0	0.3457	0.0071	0	0	0	0	0	0.0705	0	0	0	0.5009	0.0141
24-Apr-92	0	0	0.0376	0	0.3669	0	0	0	0	0	0	0.0282	0	0	0	1.4016	0.0094
26-Apr-92	0	0	0.0236	0	0.1462	0	0	0	0	0	0	0.0283	0	0	0	0.3914	0
28-Apr-92	0	0	0.0071	0	0.0071	0	0	0	0	0	0	0.0141	0	0	0	0.0071	0.0141
30-Apr-92	0	0	0.0343	0	0.0515	0	0	0	0	0	0	0.0172	0	0	0	0.7385	0
02-May-92	0	0	0.0656	0	0.1639	0	0	0	0	0	0	0.0109	0	0	0	0.9726	0
04-May-92	0	0	0.2753	0	0.5199	0.0306	0.0306	0	0	0	0	0.0918	0	0	0	1.3763	0.0612
06-May-92	0	0	0.0818	0	0.0818	0	0	0	0	0	0	0.0205	0	0	0	0.5318	0.0409
08-May-92	0	0	0.0605	0	0	0	0	0	0	0	0	0	0	0	0	0.3146	0
10-May-92	0	0	0	0	0.2666	0.0889	0	0	0	0	0	0	0	0	0	0	0
12-May-92	0	0	0	0	0.0253	0.0253	0.0253	0	0	0	0	0	0	0	0	0.0506	0.0253
14-May-92	0	0	0.1849	0	0.0462	0	0	0	0	0	0	0	0	0	0	1.1094	0.0462
16-May-92	0	0	0	0	0.0273	0	0	0	0	0	0	0	0	0	0	0.5461	0.0546
20-May-92	0	0	0.119	0	0	0	0	0	0	0	0	0	0	0	0	1.3086	0.0238
22-May-92	0	0	0.4041	0	0.0674	0	0	0	0	0	0	0	0	0	0	2.8289	0
26-May-92	0	0	0.8432	0	0	0.0206	0	0	0	0	0	0	0	0	0	4.9562	0
28-May-92	0	0	0.3972	0	0	0	0	0	0	0	0	0	0	0	0	11.385	0
30-May-92	0	0	1.1617	0	0	0	0	0	0	0	0	0	0	0	0	2.9488	0
01-Jun-92	0	0	1.0218	0	0	0	0	0	0	0	0	0	0	0	0	8.757	0
03-Jun-92	0	0	1.6732	0	0	0	0	0	0	0	0	0	0	0	0	48.575	0
05-Jun-92	0	0	2.7994	0	0	0	0	0	0	0	0	0	0	0	0	60.094	0
07-Jun-92	0	0	0.7619	0	0	0	0	0	0	0	0	0	0	0	0	10.59	0
09-Jun-92	0	0	1.1914	0	0	0	0.0056	0	0	0	0	0	0	0	0	3.4782	0
11-Jun-92	0	0	0.834	0	0	0	0.017	0	0	0	0	0	0	0	0	3.8014	0
12-Jun-92	0	0	0.459	0	0	0	0.0042	0	0	0	0	0	0	0	0	2.3497	0
15-Jun-92	0	0	0.1016	0	0	0	0	0	0	0	0	0	0	0	0	9.0912	0
17-Jun-92	0	0	0.7678	0	0	0	0	0	0	0	0	0	0	0	0	4.873	0
19-Jun-92	0	0	0.1957	0	0	0	0	0	0	0	0	0	0	0	0	3.6385	0
22-Jun-92	0	0	0.266	0	0	0	0	0	0	0	0	0	0	0	0	3.7605	0
23-Jun-92	0	0	0.1587	0	0	0	0	0	0	0	0	0	0	0	0	3.2638	0
26-Jun-92	0	0	0.144	0	0	0	0.0144	0	0	0	0	0	0	0	0	0.9286	0
29-Jun-92	0	0	0.0814	0	0	0	0	0	0	0	0	0	0	0	0	2.7692	0
01-Jul-92	0	0	0.043	0	0	0	0.0039	0	0	0	0	0	0	0	0	0.301	0
13-Jul-92	0	0	0.0306	0	0	0	0	0	0	0	0	0	0	0	0	0.3212	0
14-Jul-92	0	0	0.0155	0	0	0	0	0	0	0	0	0	0	0	0	0.1657	0
15-Jul-92	0	0	0.0508	0	0	0	0.0138	0	0	0	0	0	0	0	0	0.7155	0
20-Jul-92	0	0	0.0859	0	0	0	0.0264	0	0	0	0	0	0	0	0	1.7708	0
28-Jul-92	0	0	0.6097	0	0	0	0.0369	0	0	0	0	0	0	0	0	0.6097	0
18-Aug-92	0	0	0.0702	0	0	0	0.0083	0	0	0	0	0	0	0	0	0.2146	0
26-Aug-92	0	0	0.0093	0	0	0	0	0	0	0	0	0	0	0	0	0.0187	0
27-Aug-92	0	0	0.0373	0	0	0	0	0	0	0	0	0	0	0	0	0.0124	0
31-Aug-92	0	0	0.0262	0	0	0	0	0	0	0	0	0	0	0	0	0.0337	0
16-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	0	0	15.185	0.048	4.9988	0.1904	0.1866	0	0	0	0	0.5747	0	0	0	203.62	0.4691

Appendix C. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY CHANNEL SITE COLLECTED FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, FEBRUARY-SEPTEMBER 1992.

STATION 933 - TURNER CUT (McDonald Island)

STRIPED BASS DENSITIES (Number per Cubic Meter)

DATE	STA#	EGGS	LARVAE: SIZE GROUP 3-6 mm	7-10 mm	11-14 mm	15-18 mm	19-20 mm	3-20 mm
06-Apr-92	933	0	0	0	0	0	0	0
08-Apr-92	933	0	0.0407	0	0	0	0	0.0407
10-Apr-92	933	0	0.0492	0.0098	0	0	0	0.059
12-Apr-92	933	0	0.0216	0	0	0	0	0.0216
14-Apr-92	933	0	0.007	0	0	0	0	0.007
16-Apr-92	933	0	0.0038	0.0038	0	0	0	0.0077
20-Apr-92	933	0	0.0145	0.029	0	0	0	0.0435
22-Apr-92	933	0	0.0071	0.0071	0	0	0	0.0141
24-Apr-92	933	0	0.0094	0	0	0	0	0.0094
26-Apr-92	933	0	0	0	0	0	0	0
28-Apr-92	933	0	0	0.0071	0.0071	0	0	0.0141
30-Apr-92	933	0	0	0	0	0	0	0
02-May-92	933	0	0	0	0	0	0	0
04-May-92	933	0	0.0306	0.0306	0	0	0	0.0612
06-May-92	933	0	0.0409	0	0	0	0	0.0409
08-May-92	933	0	0	0	0	0	0	0
10-May-92	933	0	0	0	0	0	0	0
12-May-92	933	0	0	0.0253	0	0	0	0.0253
14-May-92	933	0	0	0	0.0462	0	0	0.0462
16-May-92	933	0	0.0273	0	0.0273	0	0	0.0546
20-May-92	933	0	0.0238	0	0	0	0	0.0238
22-May-92	933	0	0	0	0	0	0	0
26-May-92	933	0	0	0	0	0	0	0
28-May-92	933	0	0	0	0	0	0	0
30-May-92	933	0	0	0	0	0	0	0
01-Jun-92	933	0	0	0	0	0	0	0
03-Jun-92	933	0	0	0	0	0	0	0
05-Jun-92	933	0	0	0	0	0	0	0
07-Jun-92	933	0	0	0	0	0	0	0
09-Jun-92	933	0	0	0	0	0	0	0
11-Jun-92	933	0	0	0	0	0	0	0
12-Jun-92	933	0	0	0	0	0	0	0
15-Jun-92	933	0	0	0	0	0	0	0
17-Jun-92	933	0	0	0	0	0	0	0
19-Jun-92	933	0	0	0	0	0	0	0
22-Jun-92	933	0	0	0	0	0	0	0
23-Jun-92	933	0	0	0	0	0	0	0
26-Jun-92	933	0	0	0	0	0	0	0
29-Jun-92	933	0	0	0	0	0	0	0
01-Jul-92	933	0	0	0	0	0	0	0
13-Jul-92	933	0	0	0	0	0	0	0
14-Jul-92	933	0	0	0	0	0	0	0
15-Jul-92	933	0	0	0	0	0	0	0
20-Jul-92	933	0	0	0	0	0	0	0
28-Jul-92	933	0	0	0	0	0	0	0
18-Aug-92	933	0	0	0	0	0	0	0
26-Aug-92	933	0	0	0	0	0	0	0
27-Aug-92	933	0	0	0	0	0	0	0
31-Aug-92	933	0	0	0	0	0	0	0
16-Sep-92	933	0	0	0	0	0	0	0
17-Sep-92	933	0	0	0	0	0	0	0
23-Sep-92	933	0	0	0	0	0	0	0
TOTALS		0	0.2758	0.1127	0.0806	0	0	0.4691

Appendix C. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY CHANNEL SITE COLLECTED FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, FEBRUARY-SEPTEMBER 1992.

STATION 93 - OLD RIVER (Naglee Burk Diversion)

DENSITIES (Number per Cubic Meter)

	EGGS:	LARVAE:														
DATE	MISC.	STRIPED BASS	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRAC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS
20-Feb-92	0	0	0	0	0.2047	0	0	0	0	0	0	0	0	0	0	0	0
25-Feb-92	0	0	0	0	0.4857	0	0	0	0	0	0	0	0	0	0	0	0
28-Feb-92	0	0	0	0	0.386	0	0	0	0	0	0	0.0112	0	0	0	0	0
03-Mar-92	0.0962	0	0	0	0.2627	0	0	0	0.0037	0	0	0	0	0	0	0	0
07-Mar-92	0	0	0	0	0.7048	0	0	0	0	0	0	0.0146	0	0	0	0	0
11-Mar-92	0	0	0	0	1.334	0	0	0	0	0	0	0.0078	0	0	0	0	0
15-Mar-92	0	0	0	0	0.4695	0	0	0	0	0	0	0.0172	0	0	0	0	0
19-Mar-92	0	0	0	0	1.2061	0	0	0	0	0	0	0.0081	0	0	0	0	0
23-Mar-92	0	0	0	0	2.122	0	0	0	0	0	0	0.1188	0	0	0	0	0
27-Mar-92	0	0	0	0	0.8798	0	0	0	0	0	0	0.0187	0	0	0	0	0
01-Apr-92	0	0	0	0	0.4313	0	0	0	0	0	0	0.0254	0	0	0	0.1966	0
04-Apr-92	0	0	0.0535	0	0.6601	0	0	0	0	0	0	0.0357	0	0.0089	0	1.5164	0
06-Apr-92	0	0	0.008	0	0.4021	0.004	0	0	0.008	0	0	0	0	0	0	0.4786	0
08-Apr-92	0	0	0.0048	0	0.2851	0	0	0	0	0	0	0	0	0.0095	0	0.1948	0.019
10-Apr-92	0	0	0.0898	0	0.2295	0.005	0	0	0	0	0	0	0	0	0	2.8337	0
12-Apr-92	0	0	0.0521	0	0.0681	0	0	0	0.012	0	0	0.004	0	0	0	1.0058	0
16-Apr-92	0	0	0.1769	0	0.1308	0.0077	0	0	0.0308	0	0	0.0077	0	0	0	1.2538	0
28-Apr-92	0.0101	0	0.0201	0	0.0805	0	0	0	0	0	0	0	0	0	0	0	0.0302
30-Apr-92	0	0	0	0	0.0159	0	0	0	0	0	0	0	0	0	0	0	0.0319
02-May-92	0	0	0	0	0.0044	0	0	0	0	0	0	0	0	0	0	0.0177	0
04-May-92	0	0	0.0455	0	0.1092	0	0.0091	0	0	0	0	0	0	0	0	0.1092	0.0091
06-May-92	0	0	0.0144	0	0.0239	0.0048	0.0048	0	0	0	0	0	0	0	0	0.0575	0
10-May-92	0	0	0.0089	0	0	0	0	0	0	0	0	0	0	0	0	0.3922	0.0535
26-May-92	0	0	0.0767	0	0	0	0	0	0	0	0	0	0	0	0	0.9866	0
28-May-92	0	0	0.2121	0	0	0	0	0	0	0	0	0	0	0	0	2.1918	0
30-May-92	0	0	0.2928	0	0	0	0	0	0.0127	0	0	0	0	0	0	1.5406	0
01-Jun-92	0	0	0.2811	0	0	0	0.048	0	0.0069	0	0	0	0	0	0	1.6932	0.0069
03-Jun-92	0	0	1.0158	0	0	0	0.0127	0	0	0	0	0	0	0	0	4.8759	0
05-Jun-92	0	0	0.3429	0	0	0	0.0549	0	0	0	0	0	0	0	0	5.6027	0.0069
07-Jun-92	0	0	0.3574	0	0	0	0.0278	0	0.004	0	0	0	0	0	0	2.2438	0
09-Jun-92	0	0	0.3888	0	0	0	0.0061	0	0	0	0	0	0	0	0	2.5515	0
11-Jun-92	0	0	0.1325	0	0	0	0.0044	0	0	0	0	0	0	0	0	0.4992	0
12-Jun-92	0	0	0.0725	0	0	0	0	0	0.0045	0	0	0	0	0	0	0.3125	0
15-Jun-92	0	0	0.2692	0	0	0	0	0	0	0	0	0	0	0	0	0.3114	0
17-Jun-92	0	0	0.5115	0	0	0	0	0	0	0	0	0	0.0052	0	0	0.428	0.0052
19-Jun-92	0	0	0.514	0	0	0	0	0	0	0	0	0	0	0	0	0.7293	0
22-Jun-92	0	0	0.1337	0	0	0	0	0	0	0	0	0	0	0	0	0.633	0
23-Jun-92	0	0	0.2903	0	0	0	0	0	0.0041	0	0	0	0	0	0	0.2488	0
25-Jun-92	0	0	0.0286	0	0	0	0.0095	0	0	0	0	0	0	0	0	0.2094	0
26-Jun-92	0	0	0.0548	0	0	0	0.0137	0	0	0	0	0	0	0	0	0.1234	0
29-Jun-92	0	0	0.1408	0	0	0	0.0078	0	0.0078	0	0	0	0	0	0	0.9151	0
01-Jul-92	0	0	0.2843	0	0	0	0.0044	0	0	0	0	0	0	0	0	0.2975	0
03-Jul-92	0	0	0.1987	0	0	0	0	0	0	0.0075	0	0	0	0	0	0.27	0
13-Jul-92	0	0	0.0277	0	0	0	0	0	0	0	0	0	0	0	0	0.0198	0
14-Jul-92	0	0	0.0144	0	0	0	0	0	0	0	0	0	0	0	0	0.0622	0
15-Jul-92	0	0	0.0499	0	0	0	0.0071	0	0.0036	0	0	0	0	0	0	0.0285	0
TOTALS	0.1062	0	6.1645	0	10.496	0.0215	0.2103	0	0.0982	0.0075	0	0.2693	0.0052	0.0184	0	34.83	0.1626

Appendix C. (Cont.) ESTIMATED EGG AND LARVAL DENSITIES BY CHANNEL SITE COLLECTED FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, FEBRUARY-SEPTEMBER 1992.

STATION 93 - OLD RIVER (Naglee Burk Diversion)

STRIPED BASS DENSITIES (Number per Cubic Meter)

DATE	STA#	EGGS	LARVAE: SIZE GROUP 3-6 mm	7-10 mm	11-14 mm	15-18 mm	19-20 mm	3-20 mm
20-Feb-92	93	0	0	0	0	0	0	0
25-Feb-92	93	0	0	0	0	0	0	0
28-Feb-92	93	0	0	0	0	0	0	0
03-Mar-92	93	0	0	0	0	0	0	0
07-Mar-92	93	0	0	0	0	0	0	0
11-Mar-92	93	0	0	0	0	0	0	0
15-Mar-92	93	0	0	0	0	0	0	0
19-Mar-92	93	0	0	0	0	0	0	0
23-Mar-92	93	0	0	0	0	0	0	0
27-Mar-92	93	0	0	0	0	0	0	0
01-Apr-92	93	0	0	0	0	0	0	0
04-Apr-92	93	0	0	0	0	0	0	0
06-Apr-92	93	0	0	0	0	0	0	0
08-Apr-92	93	0	0.019	0	0	0	0	0.019
10-Apr-92	93	0	0	0	0	0	0	0
12-Apr-92	93	0	0	0	0	0	0	0
16-Apr-92	93	0	0	0	0	0	0	0
28-Apr-92	93	0	0	0.0101	0.0201	0	0	0.0302
30-Apr-92	93	0	0	0.0159	0.0159	0	0	0.0319
02-May-92	93	0	0	0	0	0	0	0
04-May-92	93	0	0.0091	0	0	0	0	0.0091
06-May-92	93	0	0	0	0	0	0	0
10-May-92	93	0	0	0.0357	0.0178	0	0	0.0535
26-May-92	93	0	0	0	0	0	0	0
28-May-92	93	0	0	0	0	0	0	0
30-May-92	93	0	0	0	0	0	0	0
01-Jun-92	93	0	0	0	0.0069	0	0	0.0069
03-Jun-92	93	0	0	0	0	0	0	0
05-Jun-92	93	0	0	0	0	0.0069	0	0.0069
07-Jun-92	93	0	0	0	0	0	0	0
09-Jun-92	93	0	0	0	0	0	0	0
11-Jun-92	93	0	0	0	0	0	0	0
12-Jun-92	93	0	0	0	0	0	0	0
15-Jun-92	93	0	0	0	0	0	0	0
17-Jun-92	93	0	0	0	0.0052	0	0	0.0052
19-Jun-92	93	0	0	0	0	0	0	0
22-Jun-92	93	0	0	0	0	0	0	0
23-Jun-92	93	0	0	0	0	0	0	0
25-Jun-92	93	0	0	0	0	0	0	0
26-Jun-92	93	0	0	0	0	0	0	0
29-Jun-92	93	0	0	0	0	0	0	0
01-Jul-92	93	0	0	0	0	0	0	0
03-Jul-92	93	0	0	0	0	0	0	0
13-Jul-92	93	0	0	0	0	0	0	0
14-Jul-92	93	0	0	0	0	0	0	0
15-Jul-92	93	0	0	0	0	0	0	0
TOTALS		0	0.0281	0.0616	0.066	0.0069	0	0.1626

Appendix D

ESTIMATED ENTRAINMENT OF EGGS AND LARVAE AND WATER VOLUME DIVERTED, BY DIVERSION SITE

Delta Agricultural Diversion Evaluation
1992 Pilot Study

Appendix D. ESTIMATED EGG AND LARVAL ENTRAINMENT LOSSES AND DIVERSIONS BY DIVERSION SITE FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 2 - BACON ISLAND

ENTRAINMENT
(Number of Fish)

DATE	LARVAE: MISC EGGS	ASHAD	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRARC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS	* DIVERSION PERIOD (Ac-Ft)
20-Apr-92	0	0	0	0	1310	0	1309.9	0	0	0	0	1310	0	0	0	0	5239.8	50.38
22-Apr-92	0	0	0	0	3275	0	3274.9	0	0	0	0	3275	0	0	0	0	13099	125.95
27-Apr-92	0	0	0	0	1613	0	0	0	0	0	0	322.5	0	0	0	322.52	967.56	25.19
28-Apr-92	0	0	0	0	3696	1848	0	0	0	0	0	1848	0	0	0	0	0	50.38
30-Apr-92	0	0	0	0	0	0	0	0	0	0	0	2583	0	0	0	0	0	100.76
04-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46.41
06-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.43
07-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.43
08-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64.82
11-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9151.7	22.93
12-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28.51
13-May-92	0	0	35704	0	0	35704	0	0	0	0	0	35704	0	0	0	35704	35704	268.68
18-May-92	0	0	14009	0	0	0	0	0	0	0	0	14009	0	0	0	28019	112074	202.04
22-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8271.1	8271.1	117.94
26-May-92	0	0	29414	0	0	0	0	0	0	0	0	0	0	0	0	12444	0	30.59
27-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1653.4	3306.7	30.73
28-May-92	0	0	9094.5	0	0	0	0	0	0	0	0	0	0	0	0	13642	0	126.59
01-Jun-92	0	0	2072.4	0	0	0	0	0	0	0	0	0	0	0	0	33159	2072.4	64.10
03-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36024	4503	63.43
05-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25372	0	126.60
09-Jun-92	0	0	3097.2	0	0	0	0	0	0	0	0	0	0	0	0	0	3097.2	65.63
11-Jun-92	0	0	4396.7	0	0	0	0	0	0	0	0	0	0	0	0	5024.8	0	25.04
12-Jun-92	0	0	18446	0	0	0	0	0	0	0	0	0	0	0	0	26352	0	94.43
15-Jun-92	0	0	2602.2	0	0	0	0	0	0	0	0	0	0	0	0	24721	0	57.55
17-Jun-92	0	0	1668.1	0	0	0	0	0	0	0	0	0	0	0	0	66724	0	43.05
19-Jun-92	0	0	2058.4	0	0	0	0	0	0	0	0	0	0	0	0	26760	0	55.43
22-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5077.6	0	17.06
23-Jun-92	0	0	25808	0	0	0	0	0	0	0	0	0	0	0	0	6452	0	17.49
24-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16.14
25-Jun-92	0	0	58069	0	0	0	0	0	0	0	0	0	0	0	0	6452.1	0	63.23
29-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1784.7	0	10.21
01-Jul-92	0	0	3186.7	0	0	0	0	0	0	0	0	0	0	0	0	9560.2	0	13.68
03-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	69912	0	22.12
06-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75466	0	9.68
07-Jul-92	0	0	11216	0	0	0	0	0	0	0	0	0	0	0	0	33648	0	13.14
09-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.51
10-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.06
13-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26.81
15-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4138.9	0	30.94
17-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47.01
20-Jul-92	0	0	24495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.74
21-Jul-92	0	524.4	917.62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.59
22-Jul-92	0	0	0	0	0	0	5253.6	0	0	0	0	0	0	0	0	0	0	10.49
23-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50.03
28-Jul-92	0	0	0	0	0	0	35303	0	0	0	0	0	0	0	0	35303	0	16.00
30-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36228	0	27.03
05-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.50
06-Aug-92	0	0	374686	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62.48
11-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24.99
13-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62.48
18-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.50
19-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.50
20-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65.85
24-Aug-92	0	0	205.76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19.83
25-Aug-92	0	0	1138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19.76
26-Aug-92	0	0	467.75	0	0	0	0	0	0	0	0	0	0	0	0	267.29	0	12.62
27-Aug-92	0	0	972.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	59.50
01-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.91
02-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.91
03-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54.55
08-Sep-92	0	0	72553	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65.45
14-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.91
15-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3066.6	0	10.91
16-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4058.8	0	12.74
17-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50.95
21-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.26
22-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11.13
23-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.71
24-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28.09
TOTALS	0	524.4	696278	0	9893	37552	45141	0	0	0	0	59052	0	0	0	635606	197487	3012.51

* Diversions for period of estimated entrainment, estimated 0 losses 9-25-92 to 10-24-92. SEASON TOTAL = 3133.05 AF

Appendix D. (Cont.) ESTIMATED EGG AND LARVAL ENTRAINMENT LOSSES AND DIVERSIONS BY DIVERSION SITE FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 3 - MCDONALD ISLAND (Unscreened)

	ENTRAINMENT (Number of Fish)																
		LARVAE:															* DIVERSION
DATE	MISC EGGS	ASHAD	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRARC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS	PERIOD (Ac-Ft)
14-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01
18-May-92	0	0	191.95	0	0	0	0	0	0	0	0	0	0	0	0	779.81	0	0.18
22-May-92	8.338	0	16.676	0	0	0	0	0	0	0	0	0	0	0	0	25.014	0	0.11
26-May-92	0	0	936.89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13
27-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.579	0	0.18
28-May-92	0	0	319.83	0	0	0	0	0	0	0	0	0	0	0	0	31.983	0	0.15
01-Jun-92	0	0	813.81	0	0	0	6.3086	0	0	0	0	0	0	0	0	0	0	0.16
03-Jun-92	0	0	249.78	0	0	0	0	0	0	0	0	0	0	0	0	10.86	0	0.25
05-Jun-92	0	0	1088.5	0	0	0	0	0	0	0	0	0	0	0	0	698	0	0.13
09-Jun-92	0	0	322.84	0	0	0	0	0	0	0	0	0	0	0	0	22.655	0	0.16
11-Jun-92	0	0	603.91	0	0	0	0	0	0	5.25	0	0	0	0	0	309.83	0	0.26
12-Jun-92	4.558	0	920.82	0	0	0	4.5585	0	0	0	0	0	0	0	0	50.143	0	0.24
15-Jun-92	2.863	0	51.537	0	0	0	2.8631	0	0	5.73	0	0	0	0	0	2287.7	0	0.15
17-Jun-92	0	0	163.87	0	0	0	0	0	0	0	0	0	0	0	0	16.807	0	0.21
19-Jun-92	0	0	51.847	0	0	0	0	0	0	0	0	0	0	0	0	20.739	0	0.27
22-Jun-92	0	0	400.74	0	0	0	0	0	0	0	0	0	0	0	0	444.45	0	0.32
23-Jun-92	4.421	0	389.02	0	0	0	0	0	0	0	0	0	0	0	0	22.103	0	0.17
24-Jun-92	0	0	213.21	0	0	0	0	0	0	0	0	0	0	0	0	55.621	0	0.37
25-Jun-92	0	0	673.17	0	0	0	13.928	0	0	0	0	0	0	0	0	37.14	0	0.18
29-Jun-92	0	0	90.991	0	0	0	0	0	0	0	0	0	0	0	0	6.9993	0	0.23
30-Jun-92	0	0	72.793	0	0	0	0	0	0	0	0	0	0	0	0	5.5994	0	0.18
01-Jul-92	0	0	134.17	0	0	0	0	0	0	0	0	0	0	0	0	19.168	0	0.22
03-Jul-92	0	0	703.68	0	0	0	0	0	0	0	0	0	0	0	0	281.47	0	0.25
06-Jul-92	0	0	290.52	0	0	0	0	0	0	0	0	0	0	0	0	581.04	0	0.42
07-Jul-92	0	0	21.017	0	0	0	0	0	0	0	0	0	0	0	0	42.035	0	0.57
08-Jul-92	0	0	9.1565	0	0	0	9.1565	0	0	0	0	0	0	0	0	0	0	0.25
09-Jul-92	0	0	781.18	0	0	0	0	0	0	0	0	0	0	0	0	130.2	0	0.24
05-Aug-92	0	0	15.191	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.14
06-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.18
19-Aug-92	0	0	47.434	0	0	0	2.7903	0	0	0	0	0	0	0	0	0	0	0.23
TOTALS	20.18	0	9574.5	0	0	0	39.605	0	0	11	0	0	0	0	0	5893.9	0	6.52

* Diversions for period of estimated entrainment, diversions ended for season on 8-19-92.

Appendix D. (Cont.) ESTIMATED EGG AND LARVAL ENTRAINMENT LOSSES AND DIVERSIONS BY DIVERSION SITE FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 3 - MCDONALD ISLAND (Screened)

ENTRAINMENT (Number of Fish)

DATE	MISC EGGS	LARVAE: ASHAD	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRARC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT-TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS	* DIVERSION PERIOD (Ac-Ft)
06-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27.40
18-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.23
22-May-92	17.01	0	17.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.22
26-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.16
27-May-92	0	0	71.839	0	0	0	0	0	0	0	0	0	0	0	0	6.5308	0	0.10
28-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.20
01-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.24
03-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.14
05-Jun-92	0	0	47.885	0	0	0	0	0	0	0	0	0	0	0	0	1687.9	0	0.24
09-Jun-92	0	0	0.6427	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03
09-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.35
11-Jun-92	13.23	0	4.4109	0	0	0	0	0	0	0	0	0	0	0	0	26.466	0	0.19
12-Jun-92	0	0	3.5791	0	0	0	0	0	0	0	0	0	0	0	0	14.317	0	0.16
15-Jun-92	3.862	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.20
17-Jun-92	0	0	6.8137	0	0	0	0	0	0	0	0	0	0	0	0	13.627	0	0.14
19-Jun-92	0	0	13.208	0	0	0	0	0	0	0	0	0	0	0	0	26.415	0	0.14
22-Jun-92	0	0	9.8551	0	0	0	0	0	0	0	0	0	0	0	0	157.68	0	0.19
23-Jun-92	38.91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.5585	0	0.27
24-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.10
25-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14.882	0	0.29
29-Jun-92	0	0	3.1285	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.10
30-Jun-92	0	0	5.783	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.19
01-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.21
03-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.8258	0	0.25
06-Jul-92	0	0	15.956	0	0	0	0	0	0	0	0	0	0	0	0	558.47	0	0.36
07-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	110.57	0	0.29
08-Jul-92	20.46	0	51.145	0	0	0	0	0	0	0	0	0	0	0	0	20.458	0	0.33
08-Jul-92	525.8	0	1314.5	0	0	0	0	0	0	0	0	0	0	0	0	525.79	0	8.44
09-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30.81
09-Jul-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25
05-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.21
05-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.32
06-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.10
06-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	112.77
19-Aug-92	0	0	6.7111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.49
TOTALS	619.3	0	1572.4	0	0	0	0	0	0	0	0	0	0	0	0	3178.5	0	195.10

* Diversions for period of estimated entrainment, diversions ended for season on 8-19-92.

SEASON TOTAL = 195.10 AF

Appendix D. (Cont.) ESTIMATED EGG AND LARVAL ENTRAINMENT LOSSES AND DIVERSIONS BY DIVERSION SITE FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 4 - NAGLEE BURK

ENTRAINMENT
(Number of Fish)

DATE	LARVAE: MISC EGGS	ASHAD	TFSHAD	DELTA SMELT	PRICKLY SCULPIN	CY-PRIN	CEN-TRARC	YF GOBY	ISS	MISC	LONGFIN SMELT	LOG-PERCH	CAT-FISH	SPLIT TAIL	SAC SUCKER	CHAM GOBY	STRIPED BASS	* DIVERSION PERIOD (Ac-Ft)
05-May-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34.17
06-May-92	0	0	203863	0	0	0	0	0	0	0	0	11992	0	0	0	59960	0	34.17
07-May-92	0	0	10192	0	0	0	0	0	0	0	0	0	0	0	0	3057.6	0	34.17
08-May-92	0	0	165470	0	0	0	10676	0	0	0	0	0	0	0	0	48040	0	102.50
11-May-92	0	0	85203	0	0	0	0	0	0	0	0	0	0	0	0	9211.1	0	34.17
18-May-92	0	0	22171	0	0	0	14780	0	0	0	0	0	0	0	0	1847.5	0	136.66
08-Jun-92	0	0	22171	0	0	0	14780	0	0	0	0	0	0	0	0	1847.5	0	34.17
09-Jun-92	0	0	14334	0	0	0	1124.3	0	0	0	0	0	0	0	0	8994	0	34.17
10-Jun-92	0	0	165895	0	0	27649	0	0	0	0	0	0	0	0	0	55298	0	34.17
11-Jun-92	0	0	20252	0	0	0	0	0	0	0	0	0	0	0	0	94510	0	34.17
12-Jun-92	0	0	155339	0	0	0	7486.2	0	0	0	0	0	0	0	0	5614.7	0	102.50
15-Jun-92	0	0	988.45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68.33
17-Jun-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3976.4	0	68.33
19-Jun-92	0	0	4084.7	0	0	0	0	0	0	0	0	0	0	0	0	16339	0	34.17
06-Jul-92	0	0	2042.3	0	0	0	0	0	0	0	0	0	0	0	0	8169.3	0	34.17
07-Jul-92	2965	0	14827	0	0	0	0	0	0	0	0	0	0	0	0	8896	0	68.33
09-Jul-92	24288	0	0	0	0	0	0	0	0	0	0	0	0	0	24288	0	0	34.17
10-Jul-92	0	0	2057.3	0	0	0	0	0	0	0	0	0	0	0	0	2057.3	0	102.50
13-Jul-92	0	0	0	0	0	0	3943.6	0	0	0	0	0	0	0	0	31548	0	34.17
05-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25680	0	34.17
06-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	136.66
15-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68.33
17-Aug-92	0	0	28995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34.17
19-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34.17
20-Aug-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	125.09
08-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	128.54
10-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29.75
14-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27.27
15-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61.32
17-Sep-92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66.06
TOTALS	27253	0	917885	0	0	27649	52790	0	0	0	0	11992	0	0	24288	385046	0	1804.64

* Diversions for period of estimated entrainment, estimated 0 losses 9-18-92 to 10-2-92. SEASON TOTAL = 1979.08 AF

Appendix E

ESTIMATED ENTRAINMENT OF JUVENILE AND OLDER FISH AND WATER VOLUME DIVERTED, BY DIVERSION SITE

Delta Agricultural Diversion Evaluation
1992 Pilot Study

Appendix E. ESTIMATED ENTRAINMENT LOSSES AND DIVERSIONS FOR JUVENILE AND OLDER FISH BY DIVERSION SITE FOR THE 1992 PILOT STUDY OF THE DELTA AGRICULTURAL DIVERSION EVALUATION, APRIL-OCTOBER 1992.

SITE 2 - BACON ISLAND

BAG NET SAMPLING

DATE	START TIME	SAMPLE LENGTH (Minutes)	CATCH (# Fish)
24-Sep-92	1106	30	0
24-Sep-92	1136	46	0
24-Sep-92	1222	54	0
28-Sep-92	1415	30	0
28-Sep-92	1450	30	0
29-Sep-92	1705	30	0
29-Sep-92	1740	30	0
29-Sep-92	1815	30	0
29-Sep-92	1850	30	0
29-Sep-92	1925	30	0
29-Sep-92	2000	60	0
30-Sep-92	1425	30	0
30-Sep-92	1500	30	0
01-Oct-92	930	90	0
01-Oct-92	1100	23	0
01-Oct-92	1124	47	0
01-Oct-92	1216	45	0
02-Oct-92	913	45	0
02-Oct-92	958	52	0
02-Oct-92	1100	47	0
02-Oct-92	1149	84	0
02-Oct-92	1235	34	0
05-Oct-92	1220	30	0
05-Oct-92	1250	30	0
05-Oct-92	1320	45	0
05-Oct-92	1405	30	0
05-Oct-92	1435	45	0
05-Oct-92	1520	40	0
06-Oct-92	1750	30	0
06-Oct-92	1825	45	0
06-Oct-92	1910	45	0
06-Oct-92	1955	770	0
15-Oct-92	1348	30	0
15-Oct-92	1418	30	0
15-Oct-92	1448	30	0
15-Oct-92	1518	30	0
15-Oct-92	1548	30	0
15-Oct-92	1618	60	0
15-Oct-92	1718	60	0
15-Oct-92	1818	930	0
16-Oct-92	948	60	0
16-Oct-92	1050	60	0
16-Oct-92	1150	60	0
16-Oct-92	1250	60	0
19-Oct-92	1215	30	0
19-Oct-92	1245	30	0
19-Oct-92	1315	30	0
19-Oct-92	1345	30	0
19-Oct-92	1415	30	0
20-Oct-92	1330	60	0
20-Oct-92	1430	60	0
20-Oct-92	1530	45	0
21-Oct-92	1145	60	0
21-Oct-92	1245	60	0
21-Oct-92	1345	60	0
21-Oct-92	1445	60	0
21-Oct-92	1545	15	0
22-Oct-92	1215	60	0
22-Oct-92	1315	60	0
22-Oct-92	1415	60	0
22-Oct-92	1515	20	0
23-Oct-92	1215	60	0
23-Oct-92	1315	60	0
23-Oct-92	1415	60	0
23-Oct-92	1515	60	0
	TOTAL		0

SITE 4 - NAGLEE BURK

JUVENILE CATCH (Number of Fish)

DATE	THREADFIN SHAD	BLUEGILL	MOSQUITO-FISH	WHITE CATFISH	CHAMELEON GOBY
05-Aug-92	0	0	0	0	0
06-Aug-92	0	0	0	0	0
15-Aug-92 *	0	0	0	0	1
17-Aug-92	0	0	0	0	1
19-Aug-92	0	0	0	0	0
20-Aug-92	0	0	0	0	0
08-Sep-92	2	0	0	0	0
10-Sep-92	0	0	0	1	0
14-Sep-92	0	0	0	0	0
15-Sep-92	0	0	0	1	2
17-Sep-92	1	0	0	0	0
28-Sep-92	0	5	0	0	0
29-Sep-92	0	2	0	0	0
30-Sep-92	0	0	0	0	1
01-Oct-92	0	0	2	1	3
02-Oct-92	0	0	0	0	2
TOTALS	3	7	2	2	9

* No sample, catch estimated in order to calculate entrainment.

SITE 4 - NAGLEE BURK

JUVENILE ENTRAINMENT (Number of Fish)

DATE	THREADFIN SHAD	BLUEGILL	MOSQUITO-FISH	WHITE CATFISH	CHAMELEON GOBY	* DIVERSION PERIOD (Ac-Ft)
05-Aug-92	0	0	0	0	0	34.17
06-Aug-92	0	0	0	0	0	136.66
15-Aug-92	0	0	0	0	96	68.33
17-Aug-92	0	0	0	0	48	34.17
19-Aug-92	0	0	0	0	0	34.17
20-Aug-92	0	0	0	0	0	125.09
08-Sep-92	64	0	0	0	0	128.54
10-Sep-92	0	0	0	69	0	29.75
14-Sep-92	0	0	0	0	0	27.27
15-Sep-92	0	0	0	77	155	61.32
17-Sep-92	63	0	0	0	0	66.06
28-Sep-92	0	289	0	0	0	38.25
29-Sep-92	0	52	0	0	0	17.06
30-Sep-92	0	0	0	0	51	40.16
01-Oct-92	0	0	72	36	109	39.89
02-Oct-92	0	0	0	0	96	39.07
TOTALS	127	341	72	182	555	919.95

SEASON TOTAL = 1979.08 AF

* Diversions for period of estimated entrainment.

COMMON ABBREVIATIONS AND METRIC CONVERSIONS

Area

km^2	square kilometers; to convert to square miles, multiply by 0.3861
m^2	square meters; to convert to square feet, multiply by 10.764

Length

cm	centimeters; to convert to inches, multiply by 0.3937
FL	fork length; length from the most anterior part of a fish to the median caudal fin rays (fork in the tail)
km	kilometers; to convert to miles, multiply by 0.62139
m	meters; to convert to feet, multiply by 3.2808
mm	millimeters; to convert to inches, multiply by 0.03937
SL	standard length; tip of upper jaw of a fish to crease formed when tail is bent sharply upward
TL	total length; length from the most anterior part of a fish to the end of the tail

Volume

AF	acre-foot; equal to 43,560 cubic feet
L	liters; to convert to quarts, multiply by 1.05668; to convert to gallons, multiply by 0.26417
mL	milliliters

Flow

cfs	cubic feet per second; to convert to acre-feet per day, multiply by 1.98
gpm	gallons per minute
mgd	million gallons per day

Velocity

fps	feet per second
m/s	meters per second; to convert to feet per second, multiply by 3.2808

Mass

kg	kilograms; to convert to pounds, multiply by 2.2046

Concentration

mg/L	milligrams per liter; equals parts per million (ppm)
µg/L	micrograms per liter; equals parts per billion (ppb)

Specific Conductance

µS	microsiemens; equivalent to micromhos
µS/cm	microsiemens per centimeter

Temperature

°C	degrees Celsius; to convert to °F, multiply by 1.8 then add 32
°F	degrees Fahrenheit; to convert to °C, subtract 32 degrees then divide by 1.8

Mathematics and Statistics

df	degrees of freedom
e	base of natural logarithm
E	expected value
log	logarithm
N	sample size
NS	not significant
%	percent
‰	per thousand
P	probability
r	correlation or regression coefficient (simple)
R	correlation or regression coefficient (multiple)
SD	standard deviation
SE	standard error
V	variance

General

CPUE	catch per unit effort
eg	for example *(exempli gratia)*
et al	and others *(et alii)*
etc	and so on *(et cetera)*
ie	that is *(id est)*

Interagency Program Members

COE	U.S. Army Corps of Engineers
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
EPA	U.S. Environmental Protection Agency
FWS	U.S. Fish and Wildlife Service
SWRCB	California State Water Resources Control Board
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey

SCIENTIFIC NAMES OF FISH

American eel	*Anguilla rostrata*
American shad	*Alosa sapidissima*
bay goby	*Lepidogobius lepidus*
bigscale logperch	*Percina macrolepida*
black bullhead	*Ameiurus melas*
black crappie	*Pomoxis nigromaculatus*
blue catfish	*Ictalurus furcatus*
bluegill	*Lepomis macrochirus*
brown bullhead	*Ameiurus nebulosus*
brown trout	*Salmo trutta*
California halibut	*Paralichthys californicus*
California roach	*Hesperoleucus symmertricus*
chameleon goby	*Tridentiger trigonocephalus*
channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscha*
common carp	*Cyprinus carpio*
delta smelt	*Hypomesus transpacificus*
English sole	*Pleuronectes vetulus*
fathead minnow	*Pimephales promelas*
golden shiner	*Notemigonus crysoleucas*
goldfish	*Carassius auratus*
green sturgeon	*Acipenser medirostris*
green sunfish	*Lepomis cyanellus*
hardhead	*Mylopharodon conocephalus*
hitch	*Lavinia exilicauda*
inland silverside	*Menidia beryllina*
jacksmelt	*Atherinopsis californiensis*
largemouth bass	*Micropterus salmoides*
longfin smelt	*Spirinchus thaleichthys*
mosquitofish	*Gambusia affinis*
northern anchovy	*Engraulis mordax*
Pacific herring	*Clupea pallasii*
Pacific lamprey	*Lampetra tridentata*
pink salmon	*Oncorhynchus gorbuscha*
plainfin midshipman	*Porichthys notatus*
prickly sculpin	*Cottus asper*
pumpkin seed	*Lepomis gibbosus*
rainwater killifish	*Lucania parva*
redear sunfish	*Lepomis microlophus*
red shiner	*Cyprinella lutrensis*
riffle sculpin	*Cottus gulosus*
river lamprey	*Lampetra ayresii*
Sacramento blackfish	*Orthodon microlepidotus*
Sacramento perch	*Archoplites interruptus*
Sacramento splittail	*Pogonichthys macrolepidotus*
Sacramento squawfish	*Ptychocheilus grandis*
Sacramento sucker	*Catostomus occidentalis*
shiner surfperch	*Cymatogaster aggregata*
silver salmon	*Oncorhynchus kisutch*
smallmouth bass	*Micropterus dolomieu*
speckled dace	*Rhinichthys osculus*
speckled sanddab	*Citharichthys stigmaeus*
splittail	*Pogonichthys macrolepidotus*
staghorn sculpin	*Leptocottus armatus*
starry flounder	*Platichthys stellatus*
steelhead trout	*Oncorhynchus mykiss*
striped bass	*Morone saxatilis*
striped mullet	*Mugil cephalus*
surf smelt	*Hypomesus pretiosus*
threadfin shad	*Dorosoma petenense*
threespine stickleback	*Gasterosteus aculaetus*
tui chub	*Gila bicolor*
tule perch	*Hysterocarpus traski*
wakasagi	*Hypomesus nipponensis*
warmouth	*Lepomis gulosus*
white catfish	*Ameiurus catus*
white crappie	*Pomoxis annularis*
white croaker	*Genyonemus lineatus*
white sturgeon	*Acipenser transmontanus*
yellow bullhead	*Ameiurus natalis*
yellow perch	*Perca flavescens*
yellowfin goby	*Acanthogobius flavimanus*